MONTHLY WEATHER REVIEW

Editor, W. J. HUMPHREYS

VOL. 63, No. 6
W.B. No. 1160

JUNE 1935

CLOSED AUGUST 3, 1935
ISSUED OCTOBER 3, 1935

METEOROLOGICAL CONDITIONS PRECEDING THUNDERSTORMS ON THE NATIONAL FORESTS

2. THE BLUE MOUNTAINS OF WASHINGTON AND OREGON

By W. R. STEVENS

[Weather Bureau, Washington, D. C, May 1935]

A series of studies are being made to determine whether any simple relationships exist between certain antecedent meteorological conditions and the occurrence of thunderstorms on the national forests in the northwestern sections of the United States, where lightning is the greatest of all forest-fire hazards and thunderstorms are so difficult to forecast with precision. The results of the first of these studies were published in the October 1934 issue of the REVIEW. Certain special terms are used in the present article which are defined in the first paper. Essentially the same methods have been employed in both studies, except that by plotting 3 elements instead of 2 on each graph the results presented in this paper are considerably better than those in the first article.

The majority of serious lightning storm days in the Blue Mountains occur in connection with troughs of low pressure which extend from northwestern Mexico to British Columbia or Alberta. The pressure distribution is quite similar to that which attends serious lightning storms in western and central Oregon, except that the trough line usually is farther to the east when serious storms occur in the Blue Mountains, often being as far as Idaho.

The season of lightning fire hazard is usually from July to about September 15. In the 7 years studied, 1925–31, inclusive, no "wide-spread" and only 1 "scattered" storm day was reported during the June months. After September 15 there was no "widespread" and only 1 "scattered" storm day. The season included in this study is the months of July and August, the season of greatest lightning fire hazard.

The following table shows the number of thunderstorm days, classified according to type, on the national forests of the Blue Mountains during the period.

JULY

	Local	Scattered	Wide-spread
1925	9	1	5
1926	7	5	1
1927	2	5	3
1928	12	4	4
1929	1	1	1
1930	7	0	3
1931	7	2	0
Total	45	18	17

AUGUST

	Local	Scattered	Wide-spread
1925	9	0	3
1926	8	1	0
1927	8	7	2
1928	7	6	1
1929	5	2	3
1930	9	0	7
1931	3	1	1
Total	49	17	17

During the 7-year period there were 8 more "local", 5 more "scattered", and 11 more "wide-spread" storm days in the Blue Mountains than in western and central Oregon.

METEOROLOGICAL CONDITIONS IN MORNING AND THUNDERSTORM ACTIVITY SAME DAY

The majority of serious storm days in the Blue Mountains occur when the 8 a. m. E. S. T. pressure at Spokane is below 29.95 inches.

During July, when the morning pressure at Spokane is below 29.95 inches and lower than at Havre or not more than 0.04 inch higher, the pressure at Baker lower than at Eureka or not more than 0.06 inch higher, and the vapor pressure at Baker 0.22 inch or higher, a dangerous thunderstorm condition exists (fig. 1).

Conditions are dangerous during July when the morning pressure at Spokane is above 29.95 inches and lower by 0.06 inch or more than at Havre, the pressure at Baker lower than at Eureka or not more than 0.12 inch higher, and the vapor pressure at Baker 0.24 inch or higher (fig. 2).

Dangerous conditions prevail during August when the pressure at Spokane is below 29.95 inches and not more than 0.02 inch higher or more than 0.26 inch lower than at Havre, the pressure at Baker lower or not more than 0.06 inch higher than at Eureka, and the vapor pressure at Baker 0.22 inch or higher (fig. 3).

During August, when the pressure at Spokane is above 29.95 inches and is the same or not more than 0.26 inch lower than at Havre, the pressure at Baker lower or not more than 0.02 inch higher than at Eureka, and the vapor pressure at Baker is 0.20 inch or higher, a dangerous thunderstorm situation exists (fig. 4).

8048—35——1

METEOROLOGICAL CONDITIONS IN MORNING AND THUNDERSTORM ACTIVITY NEXT DAY

During July, conditions are dangerous for the next day when the morning pressure at Spokane is below 29.95 inches and lower than at Havre or not more than 0.04 inch higher, the pressure at Spokane is higher than at Seattle or not more than 0.18 inch lower, and the pressure at Baker is lower than at Eureka or not more than 0.04 inch higher (fig. 5).

Conditions are dangerous during July when the pressure at Spokane is above 29.95 inches and lower than at Havre, and higher or not more than 0.10 inch lower than at Seattle, and in addition the pressure at Baker is the same or not more than 0.12 inch higher than at Eureka (fig. 6). Every "wide-spread" and "scattered" thunderstorm day reported when the pressure at Spokane was above 29.95 inches occurred under these conditions.

During August, conditions are safe for the next day when the morning pressure at Spokane is below 29.95 inches, the pressure at Seattle less than or not more than 0.04 inch higher than at Kamloops, and the Seattle pressure is less than at Roseburg (fig. 7). Otherwise rather dangerous conditions are indicated when the pressure at Spokane is below 29.95 inches.

Conditions are safe during August when the pressure at Spokane is above 29.95 inches, the pressure at Baker more than 0.02 inch higher than at Roseburg and more than 0.10 inch higher than at Havre (fig. 8). Otherwise relatively dangerous conditions are likely to occur the next day when the morning pressure at Spokane is above 29.95 inches.

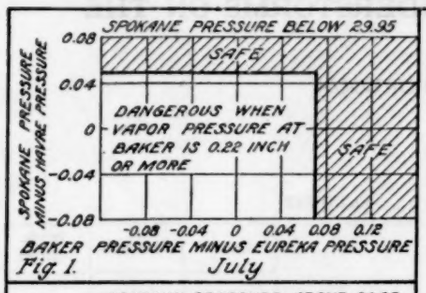
It will be noted that the last two figures do not involve a third factor. The writer has failed, although very extensive studies have been made, to discover a third factor which will improve these charts. Consequently, these charts are not as satisfactory as the others contained in this paper.

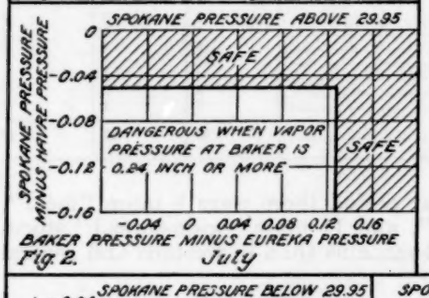
CONCLUSION

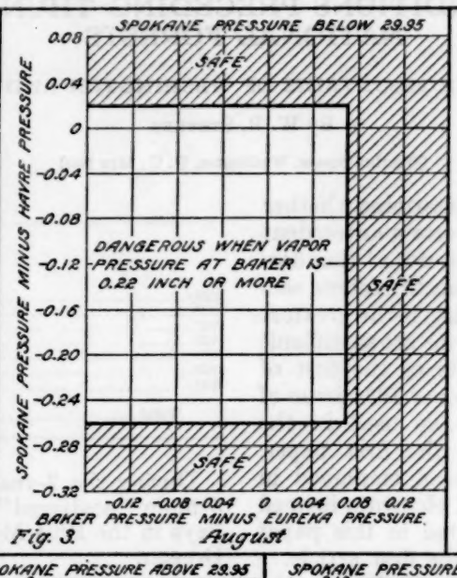
The writer wishes to emphasize that the records upon which this study is based are only 7 years in length, and that the results must not be considered as final. However, it is believed that the relationships presented will be helpful in forecasting thunderstorms for the Blue Mountains.

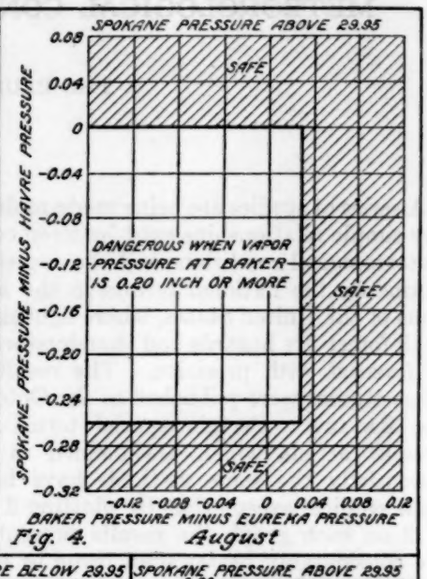
These relationships are not intended to take the place of knowledge that forecasters for the region have gained through study and experience, but rather to serve as auxiliaries to the weather map in much the same way that use is now made of auxiliary charts such as pressure change, upper air, etc.

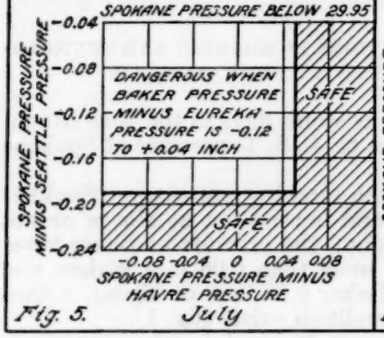
It is not presumed that the most reliable relationships that exist for the region have been presented in this paper. These simply represent the best that the writer has been able to find.

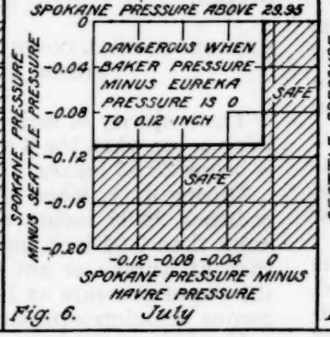

SPOKANE PRESSURE BELOW 29.95
SPOKANE PRESSURE MINUS HAVRE PRESSURE
SAFE
DANGEROUS WHEN VAPOR PRESSURE AT BAKER IS 0.22 INCH OR MORE
SAFE
BAKER PRESSURE MINUS EUREKA PRESSURE
Fig. 1. July


SPOKANE PRESSURE ABOVE 29.95
SPOKANE PRESSURE MINUS HAVRE PRESSURE
SAFE
DANGEROUS WHEN VAPOR PRESSURE AT BAKER IS 0.24 INCH OR MORE
SAFE
BAKER PRESSURE MINUS EUREKA PRESSURE
Fig. 2. July


SPOKANE PRESSURE BELOW 29.95
SPOKANE PRESSURE MINUS HAVRE PRESSURE
SAFE
DANGEROUS WHEN VAPOR PRESSURE AT BAKER IS 0.22 INCH OR MORE
SAFE
SAFE
BAKER PRESSURE MINUS EUREKA PRESSURE
Fig. 3. August


SPOKANE PRESSURE ABOVE 29.95
SPOKANE PRESSURE MINUS HAVRE PRESSURE
SAFE
DANGEROUS WHEN VAPOR PRESSURE AT BAKER IS 0.20 INCH OR MORE
SAFE
SAFE
BAKER PRESSURE MINUS EUREKA PRESSURE
Fig. 4. August


SPOKANE PRESSURE BELOW 29.95
SPOKANE PRESSURE MINUS SEATTLE PRESSURE
DANGEROUS WHEN BAKER PRESSURE MINUS EUREKA PRESSURE IS -0.12 TO +0.04 INCH
SAFE
SAFE
SPOKANE PRESSURE MINUS HAVRE PRESSURE
Fig. 5. July


SPOKANE PRESSURE ABOVE 29.95
SPOKANE PRESSURE MINUS SEATTLE PRESSURE
DANGEROUS WHEN BAKER PRESSURE MINUS EUREKA PRESSURE IS 0 TO 0.12 INCH
SAFE
SAFE
SPOKANE PRESSURE MINUS HAVRE PRESSURE
Fig. 6. July

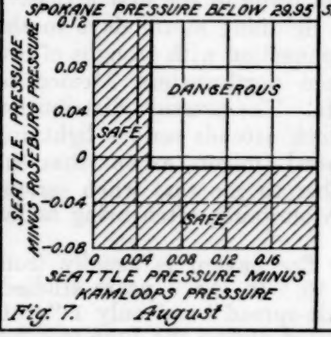


Fig. 7. August

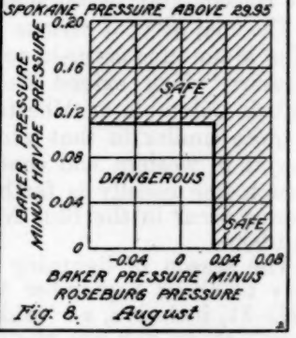
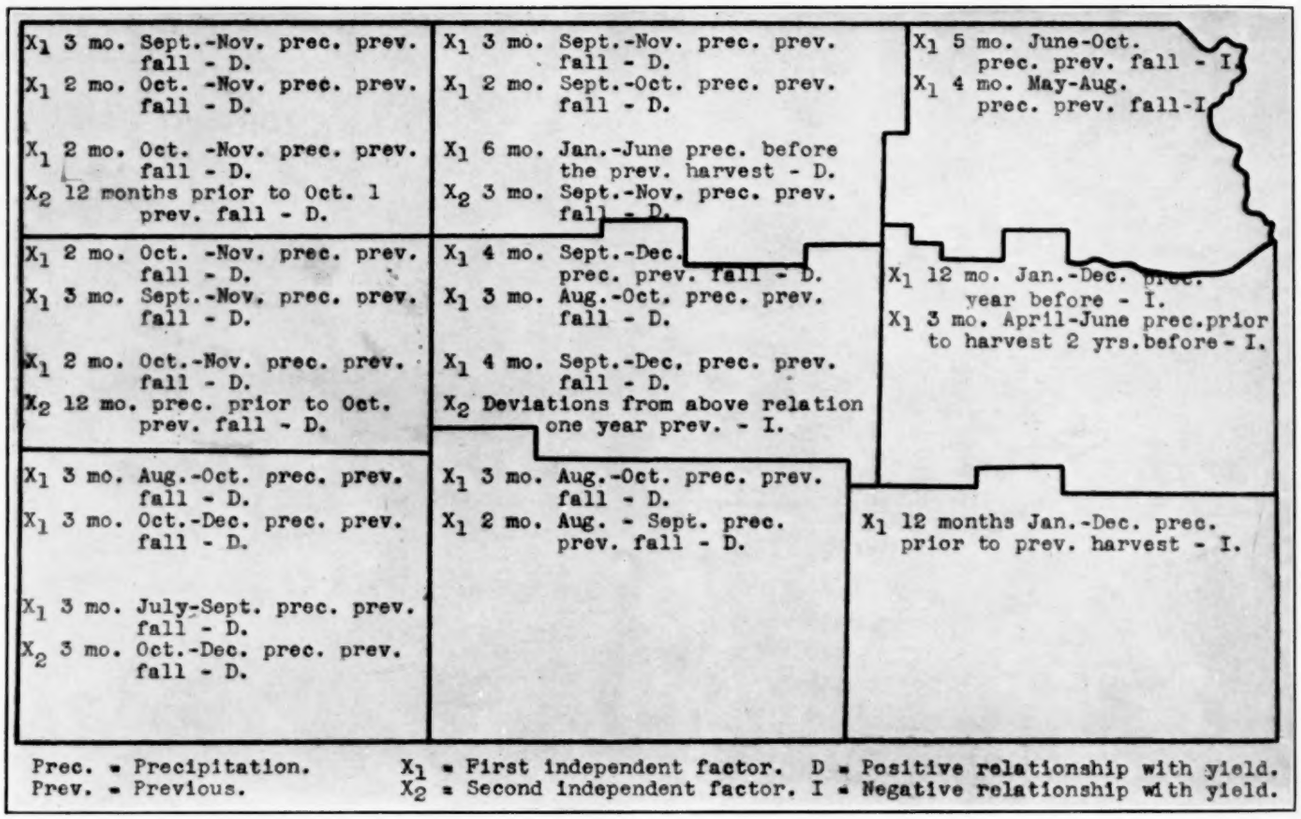


Fig. 8. August


X_1 3 mo. Sept.-Nov. prec. prev. fall - D.
X_1 2 mo. Oct. -Nov. prec. prev. fall - D.
X_1 2 mo. Oct. -Nov. prec. prev. fall - D.
X_2 12 months prior to Oct. 1 prev. fall - D.
X_1 3 mo. Sept.-Nov. prec. prev. fall - D.
X_1 2 mo. Sept.-Oct. prec. prev. fall - D.
X_1 6 mo. Jan.-June prec. before the prev. harvest - D.
X_2 3 mo. Sept.-Nov. prec. prev. fall - D.
X_1 5 mo. June-Oct. prec. prev. fall - I.
X_1 4 mo. May-Aug. prec. prev. fall-I.
X_1 2 mo. Oct. -Nov. prec. prev. fall - D.
X_1 3 mo. Sept.-Nov. prec. prev. fall - D.
X_1 2 mo. Oct.-Nov. prec. prev. fall - D.
X_2 12 mo. prec. prior to Oct. prev. fall - D.
X_1 4 mo. Sept.-Dec. prec. prev. fall - D.
X_1 3 mo. Aug.-Oct. prec. prev. fall - D.
X_1 4 mo. Sept.-Dec. prec. prev. fall - D.
X_2 Deviations from above relation one year prev. - I.
X_1 12 mo. Jan.-Dec. prec. year before - I.
X_1 3 mo. April-June prec. prior to harvest 2 yrs. before - I.
X_1 3 mo. Aug.-Oct. prec. prev. fall - D.
X_1 3 mo. Oct.-Dec. prec. prev. fall - D.
X_1 3 mo. July-Sept. prec. prev. fall - D.
X_2 3 mo. Oct.-Dec. prec. prev. fall - D.
X_1 3 mo. Aug.-Oct. prec. prev. fall - D.
X_1 2 mo. Aug. - Sept. prec. prev. fall - D.
X_1 12 months Jan.-Dec. prec. prior to prev. harvest - I.
Prec. = Precipitation.
Prev. = Previous.
X_1 = First independent factor.
X_2 = Second independent factor.
D = Positive relationship with yield.
I = Negative relationship with yield.

Factors affecting yield per acre of Kansas wheat, ranked in order of importance by crop-reporting districts

UNIV. OF MICH.

ESTIMATION OF FUTURE WHEAT PRODUCTION FROM RAINFALL[1]

By Prof. HOMER J. HENNEY

[Kansas State College, Manhattan, Kans., June 1935]

This paper deals with methods of estimating Kansas winter wheat production in crop-reporting districts, several months before harvest, on the basis of previous rainfall.

The discussion is in four parts: (1) The general procedure or technic in determining the more influential periods of rainfall; (2) important factors in each crop reporting district; (3) some of the independent factors of lesser importance; and, (4) the possibilities of making an estimate 12 to 24 months prior to harvest.

PROCEDURE AND METHOD

These studies began with efforts to correlate the subsoil moisture data for land used in experiments at the Fort Hays branch of the Kansas Agricultural Experiment Station (1) with the yields of wheat secured in the county where the Hays station is located. The study was later expanded into correlation analysis of the relation between rainfall and wheat yields by crop-reporting districts in Kansas. The original purpose was to find some means of estimating by January, February, or March, the quantity of wheat to be harvested in Kansas in late June and July. Errors made in the spring months in judging future wheat prices have been attributed to month-to-month changes in estimates of the Kansas wheat crop. Correlation studies of prices and estimates of supplies show that the change in the estimates of Southwest winter wheat production in the spring months is the most important factor causing month-to-month price changes. It has been common knowledge for years that fall rainfall is a dominant factor in winter-wheat production; i. e., rainfall above normal has been associated with yields above normal in the hard winter wheat belt, but with yields below normal in the soft winter wheat belt, and vice versa. (3)

Since the cost of obtaining data on subsoil moisture for a depth of 6, or even 3, feet by counties in Kansas would be prohibitive, and since soil moisture is dependent upon rainfall, it seemed logical that rainfall data and county yields might show a correlation. At first, calculations were based upon rainfall at one station in each county and yields in that county. This was extended to include five counties in a group. The final correlations were based upon data from the nine crop reporting districts that are set up by the Government crop reporting service. Yield and production data are more often referred to by districts, and if the estimates based upon rainfall distribution are by districts it is easier to compare them with the estimates made by interpreting a condition figure issued either by the Government or by private agencies.

Some recent studies of rainfall and crop yields made by Production Credit Association areas indicate the State of Kansas might more logically be divided into type-of-farming areas (2). Soil types are one of the important factors in determining the type-of-farming areas, and the soil reaction to rainfall distribution varies greatly within the present crop-reporting districts.

For the purpose of this paper Y will refer to the dependent factor and X_1, X_2, etc., to the independent factors.

In the studies herein reported, two general methods of making the estimate of the yield for the State were employed. The first method makes use of the independent factor in each district that shows the highest single relationship, as X_1, and this estimate is improved by applying the X_2 factor that gives the greatest reduction in the errors resulting from the first factor. The second independent factor, X_2, may not be the single factor that, used alone, gives the second best single relationship. No more than three independent factors together have been used. It might be possible to use more than three factors, especially if one started with an estimate 12 months prior to harvest and changed the estimate as combinations of monthly rainfall became available. The data prior to 1920 are not as complete and probably not as accurate as data for years since 1920, and this has necessitated the use of the shorter series of data which tends to limit all the more the number of constants one can use in the analysis.

The second method of estimating was to determine the simple relationships among the 3, 4, or 5 best factors. The modal estimate, if it could be called a modal with so few numbers, is used as the estimate for that district. These district estimates are totaled for the State average.

The first method is more scientific and should be more accurate over a period of years. It takes more time to keep that method up to date as new factors enter the situation, and it is of no more value for practical forecasting than the second method.

FACTORS AFFECTING YIELDS

The next phase of the study has to do with the more important factors that affect the yield in each district. The accompanying map of Kansas shows the crop-reporting districts (fig. 1). The State of Kansas is divided into thirds from west to east and from north to south, making nine districts. The northern three districts are numbered 1, 2, and 3 from west to east; the middle three, 4, 5, and 6, from west to east; and the southern three, 7, 8, and 9, from west to east.

Taking up the districts in numerical order, we find the most important single factor in district 1 is the rainfall during September, October, and November. The relation is direct with an index of correlation (4) of $+0.872$ and a standard error of estimate of ± 2.28 bushels per acre. The October-November or the September-October rainfall has almost as high a relation with yield. The earliest estimate for this area can be made about July 15,[2] before seeding the crop, by using the rainfall for 12 months prior to the previous harvest, which has a direct relation with yield per acre of $+0.616$. The direct relation of the rainfall so far ahead of the crop probably is due to the changes in the subsoil moisture during this period. In this district, both the acres planted and the acres harvested are related to rainfall, so that the direct relation between rainfall in the fall and total production is almost as high as the relation between rainfall and yield per acre. Whenever an area has this inner relationship, it is possible to arrive at an estimate several months earlier than when it is necessary to estimate the yield per acre

[1] Homer J. Henney, department of agricultural economics, Kansas State College of Agriculture and Applied Science, Manhattan, Kans.

[2] The 15th of the month following the month of latest rainfall is used instead of the 1st of the month following. Many times an estimate is possible by the 5th.

first and then multiply by the acres sown after the data on acres sown are released in December.

In district 2 the highest relation of yield with a single factor is with the rainfall during the September-November period; i. e., near seeding time. The relation, by using the September-October or the September-December periods, is almost as high as with the September-November period. In this district, the rainfall for the 12 months prior to the beginning of the dominant [3] period, used as a second independent factor, did not improve the estimates. The earliest estimate for this area can be made on July 15 just after the harvest of the previous crop. The rainfall for both the 6-month period and the 12-month period, prior to the harvest of the previous crop, bears a direct relation to yield. The errors in estimating from the January to June rainfall during the growing season of the previous crop are reduced by including the September-November rainfall; but this estimate, of course, cannot be made until about December 15, which is not as early as an estimate can be made by using the September-October rainfall as a single factor. The index of correlation based upon the September-November rainfall was +0.825, and by the addition of the January-June rainfall as an X_2 factor it was +0.852. The rainfall for the calendar year before harvest gave a correlation of +0.80.

In district 3, an inverse relationship appears to exist between the rainfall and yield per acre, and also between rainfall and total production. The rain during the period June to October of the previous year seems to be the most important of any during the 12 months prior to harvest. Periods longer than 5 months seem to be more important than periods of less than 5 months. When any 12-month period is considered, the period 2 years prior to harvest seems to exercise a greater effect than the year immediately prior. In other words, the rain that fell for the 12 months prior to the harvest of the previous crop seems to be more important in determining yields than rainfall during the 12 months immediately prior to a current crop.

When periods of 1 to 2 years are considered, the rainfall tends to shift acreages and yields per acre in the same direction, or the relation between the rainfall and total production is higher than the relation between rainfall and yield per acre. Just why this is true is still unknown. Some agronomists have suggested that the heavy or above-normal rains from 1 or 2 years may have leached out some of the soil nutrients, and in years of below-normal rainfalls more plant food is left for the plant to absorb. So long as rainfall is sufficient to permit the plant to absorb the remaining soluble food, the plant will react to the above-normal supply of food retained in the soil in the drier years. In the eastern third of Kansas, and probably in the soft winter wheat belt, the rainfall in below-normal periods is still sufficient to permit some food assimilation by the plant. In the western districts of Kansas, the below-normal rainfall periods do not always permit the plant to absorb the above-normal supplies of nutrients left in the soil. For that reason there tends to be a direct relation between rainfall for the previous 1 to 2 years and production. The errors in estimating are greater in district 3 and in district 9 than in most other areas. The best single relationships were with rainfall at seeding time 1 year previous and 2 years previous to harvest.

[3] Dominant period refers to the one period that by simple correlation shows the highest relationship with yield.

In district 4 the correlation between rainfall and yield per acre is distinctly direct and the correlation between acre-yield and rainfall before the previous fall tends to be direct, thus indicating the influence of the subsoil moisture. The October–November precipitation tends to give the best relation with yield per acre, giving an index of correlation of +0.766. The errors of estimate can be reduced by using rainfall for 6- to 18-month periods prior to the October–November period, but the 12-month period just previous to the dominant period gives the greatest reduction in the errors. The earliest estimate for this district can be made on July 15 just after the previous harvest, by using the rainfall for the preceding January to June.

In district 5 the central district of the State, the best single factors to use, in order of importance, are the 4 months of August–November, the 3 months August–October, and the 4 months September–December of the previous fall, The index of correlation, with the August–November rainfall and the rainfall for the 12 months prior to the August period, is +0.717. The earliest estimate for this area can be made on September 15, by using the June–August rainfall; but this estimate needs considerable revision by adjusting with the August-November rainfall, which cannot be done before December 15. The yield per acre the previous year tends to show a negative relation with the current yield. In this district a yield below normal or lower than the previous year tends to give a yield above normal or above the previous year. A preliminary estimate on this basis can be made in June. Since 1921, with the previous September–December rainfall as X_1 and the yield per acre the previous year [4] as X_2, the index of correlation is +0.815. In this district more than in any other, the cumulative rainfall for 6 months seldom constitutes as good a factor as the rainfalls during 2 periods of 3 months each. Furthermore, the center month of a 5-month period, such as September for the July–November period, increases the correlation if coupled with the 2 preceding and 2 succeeding months into 2 factors, i. e., if September, e. g., be used in a 3-month total with July and August and again in a 3-month total with October and November. This may not be orthodox statistical procedure, and it is the author's hope that someone will be able to explain the reason for this higher relationship.

In this district, the rainfall for 12 months prior to the period that shows the greatest relation exhibits an inverse relation to yield, which is contrary to findings in some other districts, especially in the western third of the State. This fact tends to verify the theory that a yield that is above normal in bushels and above normal relative to the previous rainfall, depletes the soil of certain nutrients, which in turn causes a smaller yield the following year then the rainfall would indicate. It also lends support to the theory that abnormally low rainfall, especially if accompanied by abnormally high temperatures, may result in partial sterilization of the soil, which would in turn favorably influence productivity in the next season.

In district 6, the east central district, all the relationships worked out between rainfall and yield are inverse, and tend to be higher as the length of the rainfall period is increased. One of the best relationships found in this district is between yield and the rainfall during April, May, and June 2 years prior to harvest, i. e., the rainfall for the 3 months prior to July 15 can be used in estimating

[4] This is correlated not as yield the previous year, but as yield the previous year in bushels above or below the amount estimated on the basis of rainfall for that year.

the production 24 months later. The reason for this is not known, but is apparently due to some building up of surplus soluble plant food in dry years. Likewise, this is the only eastern area where the April to June rainfall just before harvest has any measurable relation to the yield.

In district 7 the relation of all rainfall periods to yield is positive, whether to a long period of 24 months or a short period of 2 months, and also whether the period chosen is 2 or 3 years or 2 months prior to harvest. This is true of no other area. Likewise, the October–December and the January–March rainfall periods show some measurable influence which, as a rule, is not detectable in most areas. The August–October 3-month period shows the highest relation, +0.536. This estimate is improved by using the rainfall for 12 months prior to the previous August. These two factors together give +0.817. A fairly good estimate in this area can be given on September 15, 9 months before harvest, by employing the July–September rainfall. Then on January 15 this can be improved by using the October–December rainfall as an X_2 factor, and some further reductions in the error can be made on June 15 by using as an X_3 factor the March–May rainfall. This district, like district 5, shows a tendency for the errors of estimate to be plus 1 year and minus the following year.

In district 8 the same type of relationships are found as in district 5, but the correlations are not as high. The fall rainfall has a direct relation to yield, but rainfall prior to the previous harvest tends to show an inverse relation. Combinations of the fall rainfall into two or more factors give the best single or multiple relationships. These estimates can usually be improved by using the rainfall for either the 6-month or 12-month period before the previous crop. The best single factor is the August–October rainfall which has a relation of +0.694 with yield per acre. The earliest estimate in this area is in July, when one can use the January–June previous rainfall which has an inverse relation to yield, the same as in district 5.

In district 9 two conflicting relationships are present. Apparently in a series of dry years the previous fall rainfall has a direct relation, and in a series of wet years the relation is inverse. This cannot be shown statistically as yet. Errors of estimate in this area are greater than in any other district and predictions appear to be of little value. The best single relation is with the rainfall for 12 months prior to the previous harvest.

OTHER FACTORS AFFECTING YIELDS

Research studies have been conducted in an attempt to reduce the errors in judging the yield of grain. The influence of the subsoil moisture has been checked by using the accumulation of rainfall for 1 to 3 years before the dominant period. As was shown in districts 3, 5, 6, and 8 this relation is inverse to the current yield; and in districts 1, 4, and 7 it is direct.

The theory that the spring rainfall must be forecast before one can improve the estimates has been checked. To date all that can be said is that with the exception of district 7 spring rainfall tends to increase the errors as often as it reduces them. On the other hand, it is common knowledge that spring rains are essential to the crop. In most districts, however, there is some direct relation between fall and spring rainfall. This inner relationship of the two periods might explain the lack of the need for using the spring rainfall. Further studies will no doubt make it possible to improve the estimates by using spring rainfall.

The concept that a large crop is followed by a small one has been tested for all districts, and such a relation was found in districts 5, 7, and 8 to some extent. Apparently, this is important where wheat occupies the larger percentage of the cultivated area. There appear to be possibilities in such studies if they could be made by type-of-farming areas.

The relation of temperature to yield has been checked to some extent, and apparently accounts for some of the greatest errors in years of below-normal rainfall. A below-normal rainfall, with an above-normal temperature in November and December, tends to give the same yield as above-normal rainfall and normal temperature. This accounts in a large measure for the 1914 wheat crop, which was about twice as large as the fall rainfall and acreage would indicate. The standard error of estimate of the relationships given vary from 2.5 to 3.5 bushels per acre in the acres sown. These errors are reduced but little when more than two factors have been used.

LONGER TIME ESTIMATES

If possible, it is desirable to estimate the supply far enough ahead for it to be of some value in adjusting winter wheat production. From the discussion already given it is seen that a preliminary estimate can be made in most areas 1 or 2 months before seeding; and a much better estimate can be made by the time the crop goes into the dormant period, i. e., November or December. Estimates before seeding must for the most part be based on cumulative rainfall for a 12-month period prior to the previous harvest. In the eastern third of the State, the estimates are an indication of the direction of variation from the average yield, and are of a practical value when one considers the advantages in having some idea so far in advance of harvest. Since 1920 there have been only 3 years of large errors in district 3, and only 2 years of large errors in district 6. The error in the other years was negligible for long-time production planning. Since a high percent of the United States winter wheat crop is produced under conditions similar to those in the different sections of Kansas, there appears to be a possibility of using weather records to indicate desirable adjustments in wheat production.

BIBLIOGRAPHY

(1) Halstead, A. L., and Coles, E. H.
A preliminary Report of the Relation Between Yield of Winter Wheat and Moisture in the Soil at Seeding Time. Jour. of Agr. Research 41:467–477, September 1930.

(2) Hodges, J. A.
The Effect of Rainfall and Temperature on Corn Yields in Kansas. Jour. of Farm Econ. 13:305–318, April 1931.

(3) Alsberg, C. L., and Griffing, E. P.
Forecasting Wheat Yields from the Weather. Wheat Studies, Food Research Institute, vol. V. no. 1, 1928.

(4) Ezekiel, Mordecai.
Methods of Correlation Analysis. John Wiley and Sons, New York, 1930.

STUDIES OF HAWAIIAN RAINFALL

By WINTERS T. NAKAMURA

[Weather Bureau, Honolulu, T. H., May 1935]

In the estimation of the run-off for which provision must be made in sewer design, the frequencies with which rainfall occurs at a given rate during different intervals of time constitute one of the most important of the factors that have to be taken into consideration. In the first section of this paper, formulae are derived for the relation between duration and rate of rainfall at Honolulu for four values of frequency of occurrence.

The second section of the paper presents some data for the rainfall at Mount Waialeale, one of the wettest places on the globe.

RAINFALL INTENSITIES AT HONOLULU

From a chronological list of the excessive rainfalls that occurred at Honolulu during 1905–33, inclusive,[1] for 5, 10, 15, 30, 60, and 120 minutes, a table was compiled in which the observed intensities for each of these intervals, reduced to inches per hour, were arranged in order of magnitude; the average number of times per year that each intensity was equalled or exceeded during the 28 years is given by dividing the serial number of the intensity in this table by 28.

A condensed statement of the results is given in table 1. A 5-year storm, e. g., is defined as a storm that occurs once in 5 years, or 0.2 times per year. In figures 1 and 2 are plotted the data of table 1, together with the best fitting curves of the type

$$R=\frac{C}{(t+d)^e},$$

in which R denotes rainfall in inches per hour, t is duration in minutes, and d, C, e are constants (1).

TABLE 1.—*Excessive rainfalls, Honolulu, 1905–33*

Average times per year / Character of storms	0.5 2-year	0.2 5-year	0.1 10-year	0.04 25-year
Duration:	*In./hr.*	*In./hr.*	*In./hr.*	*In./hr.*
5 minutes	3.12	3.82	4.56	4.77
10 minutes	2.88	3.43	3.85	4.59
15 minutes	2.36	2.88	3.07	3.96
30 minutes	2.04	2.47	2.75	3.01
60 minutes	1.50	1.87	2.24	2.43
120 minutes			1.44	1.47

To determine the values of the constants, the equation was written in the form

$$\log R=\log C-e \log (t+d),$$

and the value of d which would give most nearly a straight line on a logarithmic plot was found by trial; this value of d was then inserted, and the values of $\log C$ and e found by the method of least squares. The results are shown in table 2.

In order to obtain results by using the data as a whole, instead of only the selected values in table 1, duration curves were also computed for the more intense rainfalls by the method of H. Alden Foster (2): Figures 3 and 4 show the intensities plotted against the observed average annual frequencies, together with the calculated duration curves; the duration curve is essentially the result of integrating the frequency curve, and shows the percentage of the time that any given rainfall intensity has been equalled or exceeded.

Table 3 gives a comparison of the observed values with those from figures 1 and 2 and figures 3 and 4. The curves of figures 1 and 2 are in slightly better accord with the observed values; but the duration curves are supposed to fit both past and future data, and are preferable for use in estimating the rainfall intensity that corresponds to any given frequency.

TABLE 2.—*Equations of rainfall curves, Honolulu, 1905 to 1933, inclusive*

Character of storms	Equation
2-year	$R=\frac{18.88}{(t+20)^{0.57}}$
5-year	$R=\frac{21.38}{(t+20)^{0.61}}$
10-year	$R=\frac{44.55}{(t+25)^{0.69}}$
25-year	$R=\frac{264.1}{(t+45)^{1.03}}$

TABLE 3.—*Rainfall intensities*

Duration (minutes)	Years per occurrence	Occurrences per year	Intensity from $R=\frac{C}{(t+d)^e}$	Intensity from duration curves	Observed intensities
			In./hr.	*In./hr.*	*In./hr.*
5	25	0.04	4.89	4.59	4.77
10	25	.04	4.42	4.13	4.59
15	25	.04	4.06	3.49	3.96
30	25	.04	3.23	2.85	3.01
60	25	.04	2.28	2.31	2.43
5	10	.10	4.28	4.16	4.56
10	10	.10	3.83	3.73	3.85
15	10	.10	3.49	3.12	3.07
30	10	.10	2.81	2.63	2.75
60	10	.10	2.08	2.06	2.24
5	2	.50	3.01	3.18	3.12
10	2	.50	2.71	2.91	2.88
15	2	.50	2.49	2.41	2.36
30	2	.50	2.03	2.14	2.04
60	2	.50	1.55	1.49	1.50

The writer here acknowledges the kind interest taken in this study by Mr. John F. Kunesh, assistant chief engineer of the Honolulu Board of Water Supply, who provided access to literature, and criticized the manuscript.

THE RAINFALL AT MOUNT WAIALEALE

The wettest place in the world is reputed to be Cherrapunji, in the Khasi Hills of Assam, India; the average annual rainfall at this station, 1851–1920, was 458 inches, and for 11 months of 1861 (March excluded) the rainfall reached the incredible total of 905 inches.

Mount Waialeale of the island of Kauai of the Hawaiian group is also one of the wettest regions on earth. Rain-

[1] The U. S. Weather Bureau defines a rainfall as excessive when the rate of fall equals or exceeds 0.01 inch per minute plus 0.20 inch. The average of the annual rainfalls at the Weather Bureau Office, 1905–1933 inclusive, is 25.25 inches.

fall measurements have been taken there from time to time since 1911 by the United States Geological Survey. The annual average from 12 years of record in the interval between 1911 and 1933 is 456 inches.

The summit of Mount Waialeale rises to a height of well over 5,000 feet above sea level, and it is situated near the geographic center of the island of Kauai. At the top the country is generally rolling in all directions

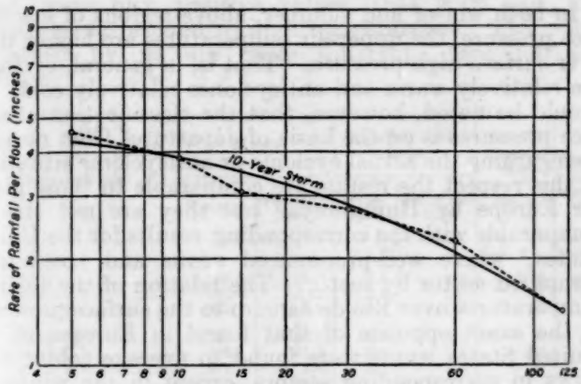


FIGURE 1.—Duration of rainfall in minutes.

except to the east where it breaks down abruptly from the rain gage and drops about 4,000 feet to form the east scarp. Due to the almost incessant rains, the region around it is a marsh, open in some places and in others covered with a forest of low trees.

A topographic map of the region discloses a long ridge that extends northeastward from the summit. East and northeast winds blowing over the plains to the south sweep into the gorge bounded by this ridge and another

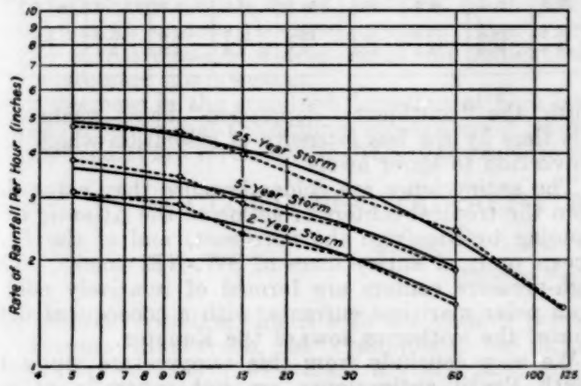


FIGURE 2.—Duration of rainfall in minutes.

shorter ridge further south and, after reaching the head of the gorge ascend the precipitous east scarp of Mount Waialeale. In ascending the winds are cooled and the moisture precipitated. The falling rain is then blown up to the top by the upward draft.

The following table, for which the writer is indebted to Mr. Max H. Carson of the Honolulu office of the United States Geological Survey, gives the annual rainfall, for either calendar or fiscal years as designated, at Mount Waialeale.

Mount Waialeale annual rainfall

Year:	Inches	Year:	Inches
1912	414	1923	360
1913	451	1924–25	362
1916	521	1928–29	354
1920	549	1930–31	528
1921	367	1931–32	527
1922	452	1932–33	592

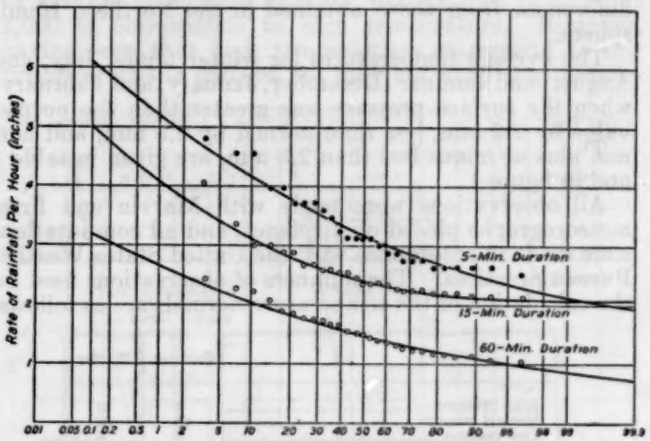

Rate of Rainfall Per Hour (inches)
5-Min. Duration
15-Min. Duration
60-Min. Duration
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.9

FIGURE 3.—Average number of storms per 100 years that will equal or exceed corresponding rate of rainfall.

The range is from 360 inches to 592 inches. The writer has found that on the Island of Oahu the variation of annual rainfall from the average is least in the mountainous, and therefore wettest, spots of the island (3). The measure of variation used was the coefficient of variation, which was 19 percent for a station with the

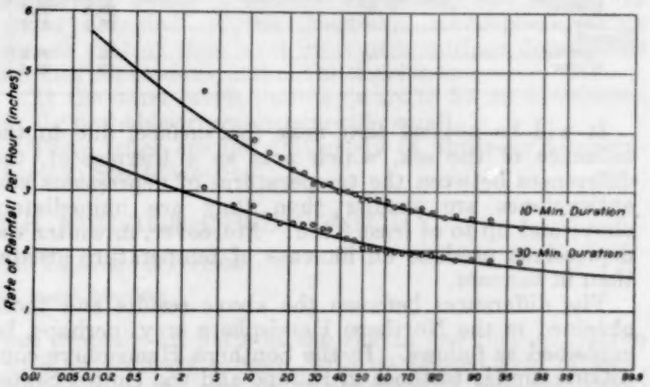


FIGURE 4.—Average number of storms per 100 years that will equal or exceed corresponding rate of rainfall.

least variation. At Mount Waialeale, also, the coefficient of variation is 19 percent.

LITERATURE CITED

(1) Bleich, S. D. Rainfall studies for New York, N. Y. Proc. Amer. Soc. Civil Engineers, February 1934.

(2) Foster, H. Alden. Theoretical frequency curves and their application to engineering problems. Trans. Amer. Soc. Civil Engineers, 1924, p. 142.

(3) Nakamura, Winters T. Study of the variation in annual rainfall of Oahu Island. Monthly Weather Review, December 1933, pp. 354–360.

TEMPERATURES IN THE LOWER 5 KILOMETERS OF THE TROPOSPHERE ABOVE RIO DE JANEIRO

By ADALBERTO B. SERRA and LAURO D. BARBOSA

[Meteorological Institution of Brazil, Rio de Janeiro, March 1935]

The data obtained from aerological soundings made at Rio de Janeiro since 1930 disclose certain interesting differences from those obtained in the Northern Hemisphere.

The average temperatures for winter (June, July, and August) and summer (December, January, and February) when the surface pressure was greater than the normal value by 2.5 mm, less than normal by 2.5 mm, and normal plus or minus less than 2.5 mm, are given in table 1 and in figure 1.

All observations were made with Marvin and Friez meteorographs placed on airplanes, and all computations were made in accordance with the United States Weather Bureau practices. The numbers of observations used for the calculation of the temperature normals are as follows:

	Summer	Winter
High pressure	9	30
Normal pressure	55	36
Low pressure	6	6

The normal temperatures are higher in summer than in winter, the difference between the means of the two seasons averaging 4.4° C.

In both winter and summer, above regions of low surface pressure, the upper-air temperatures are higher than over surface high pressure. That is, in general, cyclones are relatively warm and anticyclones relatively cold. It should be noted, however, that the classification of surface pressures is on the basis of departures from normal, disregarding the actual cyclonic or anticyclonic situation; in this respect the results are comparable to those given for Europe by Humphreys,[1] but they are not strictly comparable with the corresponding results for the United States,[2] where well-pronounced HIGHS and LOWS were compared sector by sector. The relation of the relative temperatures over Rio de Janeiro to the surface pressures is the exact opposite of that found in Europe; in the United States HIGHS were found to average colder than LOWS in corresponding sectors, except in the winter at upper levels over southern and eastern stations where the reverse was true.

TABLE 1.—*Normal temperatures at Rio de Janeiro*

Seasons (pressure)	Surface	200	500	750	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000
Summer:													
High	27.1	24.4	21.8	20.3	18.8	15.7	13.5	11.8	9.3	6.9	4.4	2.8	-------
Normal	29.0	26.7	24.8	23.4	22.0	19.4	16.4	13.6	10.9	8.1	6.0	2.6	1.0
Low	30.2	29.1	26.8	25.7	24.1	21.2	17.7	14.4	11.4	9.4	6.8	3.3	−.6
Winter:													
High	21.3	19.4	17.8	16.4	15.3	12.7	10.8	8.9	6.7	4.7	2.4	2.2	-------
Normal	23.4	22.5	20.6	19.0	17.4	14.9	12.2	9.0	6.4	5.0	2.9	−.3	−4.8
Low	25.2	25.7	24.0	23.0	21.7	18.1	14.8	11.1	6.9	4.9	.2	−1.6	−3.0
Normal:													
Summer	28.8	26.6	24.6	23.2	21.8	19.0	16.2	13.4	10.7	8.0	5.9	2.8	.6
Winter	22.7	21.5	19.7	18.3	16.9	14.2	11.9	9.2	6.6	4.9	2.6	.0	−4.5

It will be noticed that near the surface, due to the influence of the sea, which acts as a thermostat, the differences between the temperatures of depressions and anticyclones are smaller than they are immediately above and up to at least 2 km. Moreover, in winter the depressions produce an increase of temperature greater than in summer.

The differences between the above results and those obtained in the Northern Hemisphere may, perhaps, be explained as follows. In the Southern Hemisphere conditions similar to those in Europe and the United States occur only near the antarctic circumpolar circle, where families of cyclones are continually passing, according to Bjerknes, and producing rainy weather and "the brave westerlies." In the Rio de Janeiro region, however, the depressions are generally extensions from the semipermanent LOW which occupies the center of South America, and is produced by the intense insolation there. This region is occupied, therefore, by a warm air mass.

A fusion with the so-called "continental depression" (permanently hot center of the continent) is frequent in winter when a depression from high latitudes reaches Rio de Janeiro; in that case the temperatures remain relatively high, as far as 3,000 m, but the Northern Hemisphere "cold LOW" appears above this level. Doubtless there is at this level a predominance of the low temperatures of cold depressions coming from the south, the "continental depression" being weakened at this time by the less intensity of insolation which limits convection to lower levels.

The anticyclones are colder because they come down from the tropical centers of action of the Atlantic Ocean (coming to Rio from the northeast) and of the Pacific Ocean (normal anticyclones of SW.-NE. track). These high-pressure centers are formed of relatively cold air from polar maritime currents, with a consequent deflection of the isotherms toward the Equator.

We may conclude from this temperature study that South Brazil anticyclones are not generally of polar origin but are formed in the oceanic centers of action.

The differences of temperature between the surface and 4,500 meters are:

Summer		Winter	
Anticyclone	Depression	Anticyclone	Depression
24.3° C.	26.9° C.	19.1° C.	26.8° C.

We conclude, therefore, that the fall of temperature is always the same in depressions, both in summer and

[1] W. J. Humphreys, Physics of the Air, 2 ed., p. 54.
[2] L. T. Samuels, MONTHLY WEATHER REVIEW, May 1926, p. 208-209, tables 11 and 12.

winter, which seems to show that convection and turbulence are equally strong in the two seasons.

The fall of temperature is greater in depressions than in anticyclones because in the first case convection is more active. For the same reason, the decrease of temperature in anticyclones is greater in summer than in winter.

The correlation coefficients between pressure and temperature, calculated by Dines from soundings in England, gave high positive values, that is to say, high pressures correspond to high temperatures. The results obtained by us are quite different. (See following table.)

Seasons (levels)	Means		Standard deviations		Correlation coefficients	Probable errors
	Pressure	Temperature	Pressure	Temperature		
Summer:						
Surface	1,008.9	28.8	3.1	2.9	−0.26	±0.08
2,000 m. s. l.	804.6	16.2	2.1	2.8	+.23	±.08
4,000 m. s. l.	633.7	5.9	2.1	1.7	+.42	±.10
Winter:						
Surface	1,017.6	22.7	4.2	2.7	−.55	±.06
2,000 m. s. l.	808.1	11.9	2.4	3.3	−.03	±.08
4,000 m. s. l.	634.2	2.6	3.1	3.5	+.91	±.03

From an examination of the mean values we may conclude that in winter the surface pressure is normally 8.7 mb higher than in summer. The difference becomes 3.5 mb at 2,000 m, and 0.5 mb at 4,000 m.

Pressures higher in winter than in summer are common above the continents at low levels, on account of the warming of the surface during the latter season.

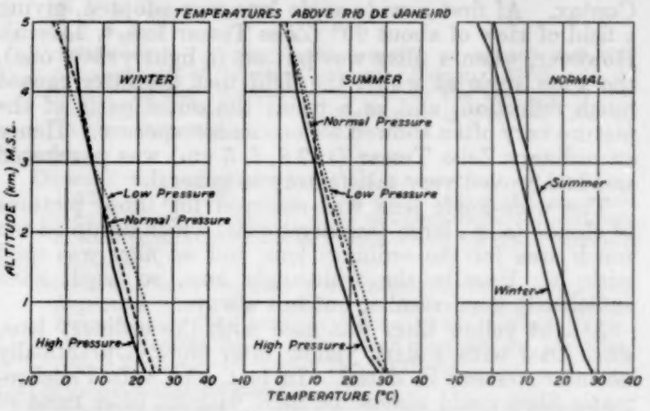
In summer, however, at very high levels, the heating is less and therefore the fall of pressure is also less than at the surface.

The standard deviations of pressure are higher in winter than in summer, because in winter there is great activity in the passage of depressions and anticyclones, while in summer this is weakened.

The decrease in the standard deviation at high levels seems to indicate that the original oscillations of pressure are amplified at low levels by the effect of the surface temperature. It also indicates that cyclones and anticyclones reach at least 4,000 m.

The standard deviations of temperature are higher in winter on account of the great activity of the secondary circulation, with consequent frequent passages of air masses with different temperatures.

The significance of the correlation coefficients is somewhat uncertain. There is, perhaps, positive correlation at 4,000 m in summer (+0.42), that is, high pressure at 4,000 m corresponds to high temperature. However, having seen that high temperatures correspond to low pressures at the surface, we may conclude that depressions at the surface have, at 4,000 m, relatively high pressure, and vice versa. This conforms to the classic theory that depressions are formed by local heating.



There is also a negative correlation coefficient (−0.55) at the surface in winter (depressions warmer than anticyclones.) At 4,000 m there is a very high positive coefficient (+0.91), already explained, and similar to those obtained in the Northern Hemisphere. This means that at that level, in winter, surface depressions are still depressions, and not anticyclones.

At the other levels there appears to be no correlation at all; probable errors are generally small.

These notes are the first study of upper-air temperatures in South America.

CLOUD PHOTOGRAPHY AT THE MANILA OBSERVATORY

By Rev. C. E. DEPPERMANN, S. J., Assistant Director

[Philippine Weather Bureau, Manila, May 1935]

In order to correlate clouds with the various types of air currents that reach the Philippines, the Manila Observatory in May 1934 started a year's photography of clouds. Now that the program has been successfully completed, a few words as to the plan of campaign and the results achieved may be of interest.

It was quite a problem to decide upon the best method of procedure. Many have advocated the use of a cylindrical or "fish-eye" lens, of the type suggested by Wood in his Physical Optics, or at least some very-wide-angle lens, to enable the photographer to cover most of the sky in one picture. This would be an advantage, of course, if it could be done cheaply and efficiently. However, a lens of this type would be very expensive, and a special shutter would be imperative to get proper distribution of light intensity. Experience, moreover, has shown the writer that the sky very often shows remarkable contrasts in light intensity, especially in stormy weather, and no shutter would be equal to the task of bringing out properly all parts of the sky in one picture. Even with an ordinary camera, with its limited field of view, certain pictures have to be consistently rejected, unless the photographer when printing is prepared for the task of delicate "dodging", i. e., of shading parts of the negative. To take several pictures at a time of *ordinary size*, say 4 by 5 inches, or 5 by 7 inches, and select characteristic parts of the sky, is another alternative, but the cost would be very high, if one wishes, as I did, to take some 20 or more pictures a day, and often, in striking situations, 5 or 6 in rapid succession. The frequent loading of the ordinary rolls of 6 or 8 pictures would also be very inconvenient.

After much deliberation the following scheme was adopted and has proved quite satisfactory; the cost, though considerable, has not been prohibitive, considering the ambitious nature of the project. A Contax camera was purchased, using movie film, 36 pictures to a roll, but taking a picture twice as large as the ordinary

movie camera. The size is admittedly small, but the definition is excellent, and with the aid of an ordinary reading glass all necessary cloud detail can usually be seen. A diary was kept of exposure times, the general sky and weather conditions at the time of taking the picture, together with positive, actual-size pictures. The diary at the end of the year contained some 5,000 pictures of clouds. Some 600 of the best typical pictures have been enlarged to size 5 by 7 inches.

A few more details will now be given as to the camera and method of procedure:

The camera and lenses.—The camera used was a Zeiss Contax. Af first a wide-angle lens was adopted, giving a field of view of about 90° (Zeiss Tessar 1: 8, f. 2.8 cm). However, when a filter was put on (a light yellow one), the wide angle at which the light met the filter caused much reflection, and as a result the outer parts of the picture very often showed serious underexposure. Hence an ordinary Zeiss Tessar (1: 2.8, f. 5 cm) was purchased and has proved very satisfactory in general.

The wide-angle lens was reserved for those pictures of clouds (e. g., large thunderstorms) which occupied too much area for the ordinary lens, but *no filter* was used with it. Usually the wide-angle lens, so used, gave sufficiently good results, but not always.

A light yellow filter was used with the ordinary lens, since trial with a dark yellow filter showed practically no improvement in detail. In fact, the Agfa Panchromatic films could almost be used without filter most of the time.

Films.—In the tropics, one cannot always get the film one desires, and we were compelled to start out with Superpan films. For the natural size small positives, this gave good results; but when enlargements to 5 by 7 inches are in question, or projection on a screen, then the grain of the Superpan becomes quite perceptible. Isopan films were used as soon as they arrived in Manila and these gave a smaller grain. Finally during the last month of work, the Finopan came, which for fineness of grain leaves really nothing to be desired.

Development.—Fine-grain developers of various types were tried, but they all proved unsatisfactory, due to lack of sufficient contrast in the negatives. Delicate cirrus clouds, or misty cloud effects, etc., would not come out properly; the fine details were lost, and many pictures, too many in fact, were quite flat. We therefore perforce had to use a contrast developer; but, alas, this also enlarged the grain. The grain, however, though at times not so pleasing to the eye on 5- by 7-inch enlargements, was not large enough to spoil details, and so for our films Eastman D–11 developer (time 5 minutes, starting at 16° C.) has been almost exclusively used. It was thought better to possess the requisite cloud details with a somewhat larger grain on enlargements (of course on the small prints there is no trouble about grain), than to have smoothness with flatness and loss of detail. Perhaps in other climates, with clearer air, fine-grain developers would work better. The films in the tropics after development must be very thoroughly washed. Father Doucette, Chief, Meteorological Section of the Observatory, kindly did all the developing of the films, while the writer took the pictures and did all the printing and enlarging. In this way, though it took much time, the cost of the program was considerably reduced.

Printing.—For this, Eastman D–72 developer (homemade as was the D–11, by Father Doucette), diluted to proper proportions (1 part developer to 2 parts water) and Azo No. 5 or No. 3 paper, were used. *Very* thorough washing and the use of hypo *only once* were found necessary to prevent the prints from turning brown after some months.

Enlarging.—To have 5- by 7-inch enlargements made outside would have been very costly, and not so satisfactory, since it would be difficult for another to estimate rightly the proper shade of the clouds. It was found cheaper and much more satisfactory to make the enlargements ourselves, using a Zeiss "Magniphot." To get sufficient contrast on these enlargements, D–11 developer was again used, undiluted, and proved excellent when used in conjunction with News Bromide Contrast paper (or Medium for the more naturally contrasty pictures). With the new Finopan films, enlargements of this size, developed as indicated, give hardly any grain, and show exquisite detail and contrast.

Taking the pictures.—About 20 pictures a day were taken as a rule (the number varying with sky conditions), usually at intervals of 1 or 2 hours. An Ombrux exposure meter, which is reasonable in price and very satisfactory, was found an absolute necessity to gage exposures of clouds correctly. One had to learn, too, not to take pictures too near the sun or with too much contrast; this is especially true for pictures of squalls, storm clouds of various kinds, etc. The eye has a remarkable power of adaptation to varying degrees of light intensity, and only an exposure meter insures consistently good exposure times. This consistency is a necessity, for it must be remembered that the film roll has 36 pictures, and there can be no individual development, and this latter must be done in a tank in perfect darkness, since the films are so very sensitive to light. Even with a yellow filter, the oridinary exposure time used was one one-hundredth second, stop 8.

So much for the method. Now there remains the onerous task of studying the pictures in relation with the weather map. It will, in all probability, be a year or more before the results of such analysis can be published.

BIBLIOGRAPHY

C. FITZHUGH TALMAN, *in Charge of Library*

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Blacktin, Samuel Cyril.
Dust. London, Chapman & Hall, ltd., 1934. xi, 296 p. front., pl., diagrs. 22 cm. "References": p. 259–275.

Blair, Thomas Arthur.
Syllabus in elementary meteorology. Lincoln. 1935. 118 p. plates (part. fold.) 28 cm. (Manifolded).

Brooks, Charles Franklin.
Why the weather? . . . with the collaboration of Eleanor Stabler Brooks and John Nelson; illus. with photographs. Rev. & enl. New York. 1935. xvii, 295 p. front., illus., plates, diagr. 21 cm.

Brunt, David.
Physical and dynamical meteorology. New York, Macmillan. 1934. xxii, 411 p. illus. (maps, charts), diagrs. 26½ cm.

Díaz, D. Severo.
Le previsión del tiempo en México. Guadalajara. 1934. p. 189–216. 22½ cm. (Bol. de la Junta auxiliar Jalisciense de la Soc. mexicana de geogr. y estad. 18 de abril de 1934).

Duperier, A.
Distribución vertical de la temperatura en la atmósfera del centro de España. Madrid. 1933. 10 p. diagr. 24½ cm. (Serv. meteor. españo. Serie A, núm. 1.)

Gregg, Willis R.
The Weather Bureau and the nation's business. n. p. 1934. 3p. 27 cm. (Manifolded).

Guardiola, Jose M.ª Jansa.
Contribución al estudio de la tramontana en Menorca. Madrid. 1933. 35 p. 2 pl., tab., diagr. 24 cm. (Serv. meteor. español. Serie A, núm. 3.)

Guerrieri, Eugenio.
L'anormalità delle due ultime estati del 1930 e del 1931. (R. Oss. astron. di Capodimonte. Contrib. geofisici N. 17.) Napoli. 1932—X. 15 p. tab., diagr. 24 cm. (Extr.: Riv. di fisica, matematica e scienze naturali. Anno VI, fasc. 7. Maggio 1932—X.)

Haskin, Frederic J.
The American government today. New York, Grosset & Dunlap [° 1935]. x, 470 p. 21½ cm. (Chap. XVI, "The Weather Bureau", pp. 143–150.)

Heide, Fritz.
Kleine Meteoritenkunde. Berlin, J. Springer. 1934. 119 p. illus., maps, diagrs. 18½ cm. (Verständliche wissenschaft. 23. Band.)

Jamaica. Government meteorologist.
A report on the hurricane of western Jamaica, October 29, 1933. Kingston. 1934. 11 p. 1 pl., tabs. 32 cm.

Kidson, E., and Ewart, M. E.
A year's wind records. (Meteorological office note no. 14.) Wellington. 1933. p. 208–221. tab., diagr. 25 cm. (Extr.: New Zealand jnl. science and tech., v. XV, no. 3. 1933.)

Livathinos, A. N.
Étude sur la pluie à Athènes. Athènes. 1935. [12 p.] tab., diagr. 29½ cm. (Extract: Annales de l'Obs. nat'l d'Athènes. T. XII, p. 121–132.)

Lunelund, Harald.
Die Helligkeit in Finnland. n. p. 1935. 42 p. tab., diagr. 24 cm. (Soc. scient. Fenn. Comment. phys.-math. VIII. 7.)

Mariolopoulos, E. G.
Bibliographie du climat de la Grèce. Athènes. 1934. n. p. 29½ cm. (Extract: Ann. Obs. nat'l. Athènes, t. XII.)
——— Étude des régimes pluviométriques de la Grèce. Athènes. 1934. 13 p. maps (1 fold.) 29½ cm. (Extr.: Ann. Obs. nat'l. Athènes, t. XII.)

Navarrete, Julio Bustos.
Historia del Observatorio del Salto. Memoria presentada a la Sociedad cientifica de Chile. Santiagoe de Chile. 1934. 16 p. ill. 26 cm.

Niebrzydowski, W.
S. p. Stefan Hlasek-Hlasko. Warszawa. 1934. 12 p. pl. (ports.) 31 cm. (Extr.: Bull. mét. et hydrog., 1934, N. 7–12.)

Petterssen, Sverre.
Practical rules for prognosticating the movement and the development of pressure centers. Bergen. 1933. 44 p. diagr. 28 cm. (Report presented at the meeting of the International union of geodesy and geophysics, Lisbon 1933.) (Manifolded.)

Reja, Oskar.
Odonsaji med padavinami in cikloni v Jugoslaviji. Ljubljana. 1933. p. 165–180. figs. 26½ cm. (Geografskega vestnika. Année 9. 1933.) (Les relations entre les cyclones et les précipitations dans la Yougoslavie.) [French résumé.]

Sparn, Enrique.
Bibliografía meteorológica y climatológica de la República Argentina y de las regiones Antártica y Sub-Antártica Americanas. 1924–1931. Córdoba. 1934. 47 p. 23 cm. (De la Revista de la Universidad nacional de Córdoba, Año XX—nos. 9–10, Nov. y Dic. de 1933.)

U. S. National resources board.
A report on national planning and public works in relation to natural resources and including land use and water resources with findings and recommendations. December 1, 1934. Submitted to the President in accordance with Executive order no. 6777, June 30, 1934. Washington. 1934. vii, 455 p. incl. illus., tables. maps (part fold.) diagrs. (part fold) charts (part fold.) 29½ cm.

Veryard, R. G.
Scent and the weather. Peshawar. [1935.] 33 p. pl., tab., diagr. 22½ cm.

SOLAR OBSERVATIONS

By IRVING F. HAND, Assistant in Solar Radiation Investigations

SOLAR RADIATION MEASUREMENTS DURING JUNE 1935

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged above normal at all three Weather Bureau stations.

With the exception of the western and southern stations, Fresno, Twin Falls, and Miami, table 2 shows an excess in the amount of total solar and sky radiation received on a horizontal surface. With the receipt of a new Eppley thermoelectric pyrheliometer, La Jolla again began regular measurements of total solar and sky radiation early in April. Values in gram-colories for the weeks beginning April 9, 1935, up to and inclusive of the week beginning with May 28, 1935, follow: 543, 525, 496, 620, 510, 553, 556, and 472 respectively. Beginning with this issue, these values will regularly appear in table 2.

Polarization measurements obtained on five days at Washington give a mean of 58 percent with a maximum of 60 percent on the 20th. At Madison, observations taken on five days give a mean of 62 percent with a maximum of 67 percent on the 7th. Both means are close to the respective normals for the stations for June, but in both cases the maximums are slightly below the June normals.

TABLE 1.—*Solar radiation intensities during June 1935*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance									
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
June 1	7.19					1.36					5.79
June 5	9.47	0.52	0.60	0.82	1.16	1.42					7.87
June 6	10.59		.82	.96	1.12	1.40					8.81
June 12	12.24					1.24					10.59
June 13	15.11					1.32	1.06				9.47
June 20	9.47		.87	1.04	1.23	31.41					9.83
June 24	10.59		.71	.88							10.21
June 25	10.59				1.11	1.41					9.14
June 27	16.20				.87	1.16					15.65
June 28	15.65				.83						13.13
Means		.52	.75	.96	1.05	1.34	1.06				
Departures		−.05	+.08	+.18	+.11	−.10	−.12				

TABLE 1.—*Solar radiation intensities during June 1935*—Contd.

MADISON, WIS.

Date	Sun's zenith distance: 8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
June 4	7.87	------	0.44	0.70	0.98	1.19	------	------	------	------	8.18
June 7	7.29	------	.96	1.09	1.27	1.50	------	------	------	------	5.16
June 8	6.76	------	.95	1.07	1.25	------	------	------	------	------	6.02
June 11	12.24	------	------	------	------	1.30	------	------	------	------	13.61
June 12	10.59	------	------	------	------	1.40	------	------	------	------	12.24
June 13	13.61	------	------	------	------	1.47	------	------	------	------	16.20
June 20	8.18	------	------	1.13	------	------	------	------	------	------	8.81
June 22	9.83	------	.94	1.05	1.24	1.45	------	------	------	------	9.47
June 24	10.21	------	.85	1.03	------	------	------	------	------	------	9.47
June 27	15.11	------	------	.97	1.26	1.44	------	------	------	------	10.97
June 29	13.13	------	------	------	------	1.37	------	------	------	------	13.13
Means	------	------	.83	1.01	1.20	1.39	------	------	------	------	------
Departures	------	------	−.02	+.04	+.17	+.06	------	------	------	------	------

LINCOLN, NEBR.

June 3	8.81	------	.96	1.10	1.27	1.44	------	------	------	------	.704
June 4	6.76	------	.91	1.06	1.29	1.50	------	------	------	------	7.29
June 5	8.18	------	------	------	1.08	1.48	------	------	------	------	8.18
June 7	6.27	------	.90	1.06	1.36	1.50	------	------	------	------	5.79
June 11	10.59	------	------	------	------	------	1.17	1.05	0.89	0.77	8.81
June 13	14.60	------	.84	.91	------	------	------	.91	.75	------	16.20
June 19	10.27	.87	.99	1.11	------	------	------	------	------	------	9.57
June 22	12.24	------	.92	1.06	1.22	1.48	------	------	------	------	12.24
June 25	14.60	------	------	------	1.07	1.37	1.17	1.01	.84	------	14.10
June 26	11.81	------	------	------	------	------	1.22	1.04	.84	------	14.60
Means	------	.87	.90	1.05	1.22	1.46	1.12	.95	.78	.60	------
Departures	------	+.11	+.12	+.12	+.12	+.11	+.02	+.04	+.00	+.04	------

TABLE 1.—*Solar radiation intensities during June 1935*—Contd.

BLUE HILL, MASS.

Date	Sun's zenith distance: 8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	80.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
June 1	9.6	------	------	------	------	------	1.13	------	------	------	8.8
June 2	9.6	------	0.86	1.02	1.19	1.42	1.20	------	------	------	7.4
June 3	9.6	------	------	------	------	1.40	------	------	------	------	8.6
June 7	11.11	------	------	------	.91	.97	.78	------	------	------	11.1
June 12	11.1	------	------	------	------	1.14	.85	------	------	------	7.9
June 13	11.1	------	------	------	1.06	1.15	1.02	------	------	------	9.6
June 14	7.9	------	------	------	------	1.40	------	------	------	------	6.8
June 16	9.9	------	------	------	------	------	1.22	------	------	------	8.2
June 17	12.8	------	------	------	.82	1.07	------	------	------	------	14.7
June 23	10.7	------	------	------	1.02	1.24	------	------	------	------	8.8
June 24	11.5	------	------	.87	1.10	1.34	------	------	------	------	9.2
June 26	11.5	------	------	1.17	1.25	1.33	------	------	------	------	10.3
June 27	14.3	------	------	------	1.00	1.18	.96	------	------	------	13.2
June 28	15.8	------	------	------	1.01	1.32	------	------	------	------	7.9
June 30	15.8	------	------	------	.79	1.12	.89	------	------	------	13.7
Means	------	------	.86	1.02	1.02	1.24	1.01	------	------	------	------

*Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Friday Harbor	Ithaca	San Juan
	Gram-calories per square centimeter															
1935	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
June 4	467	441	530	406	288	746	478	702	332	461	370	606	273	593	436	624
June 11	528	438	481	496	567	761	546	665	584	542	399	589	597	512	568	773
June 18	489	382	543	399	392	779	454	716	580	349	465	575	473	577	280	803
June 25	542	395	570	427	566	773	442	546	589	365	384	524	697	536	639	671
	Departures from weekly normals															
June 4	−28	−70	−20	−28	−128	+96	+22	+121	−102	−66	−76	+43	------	------	------	------
June 11	+31	−63	−56	+59	+20	+51	+47	+24	+150	+63	−49	0	------	------	------	------
June 18	−5	−140	−26	−57	−139	+56	−66	+13	+95	−134	+51	−30	------	------	------	------
June 25	+12	−138	−28	−5	+9	+52	−35	−110	+86	−154	−20	−77	------	------	------	------
	Accumulated departures on July 1, 1935															
	−2,842	−8,610	−8,190	+1,358	+2,625	+2,086	+1,617	+1,064	------	−2,275	−952	−4,172	------	------	------	------

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during June 1935 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{y-r}}{1.94}$	$\frac{I_{m-r}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
June 20, 1935	° ′	*m*	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
4:49 a. m.	27 52	2.14	1.191	0.862	0.681	0.034	0.040	0.037	74.8	10.9	10.2	N_{PC}
4:44 a. m.	28 09	2.07	1.205	.864	.684	.030	.044	.037	78.6	14.0	35.0	
4:03 a. m.	36 46	1.67	1.278	.911	.705	.018	.021	.020	83.3	15.4	35.0	
3:59 a. m.	37 33	1.64	1.286	.917	.707	.017	.021	.019	83.9	15.5	35.0	
June 25												
2:30 a. m.	54 30	1.23	1.311	.892	.688	.054	.058	.056	80.6	10.7	10.4	N_P
2:24 a. m.	55 48	1.21	1.308	.892	.688	.058	.064	.061	85.2	10.4	10.3	
2:12 a. m.	58 01	1.18	1.331	.896	.701	.062	.054	.058	81.1	10.3	10.2	
2:09 a. m.	58 34	1.17	1.333	.896	.701	.062	.058	.060	80.9	10.3	10.2	
1:06 a. m.	61 40	1.07	1.380	.932	.716	.068	.068	.068	81.3	9.0	9.7	
0:53 a. m.	70 50	1.05	1.371	.932	.716	.072	.070	.071	81.2	9.4	9.7	

Atmospheric conditions during turbidity measurements:
June 20. Temp. 15° C., wind, NW. 12; visibility, 50 miles; polarization, 60.4 percent; blueness of sky, 6.
June 25. Temp. 16° C., wind, NW. 10; visibility, 30 miles; polarization, 59.8 percent; blueness of sky, 5.

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

June 1, 1935												
4:34 a. m.	30 14	1.98	1.105	0.792	0.641	0.066	0.079	0.072	69.0	10.5	7.1	P_A
3:05 a. m.	46 36	1.38	1.267	.871	.693	.047	.072	.060	78.8	11.6	10.4	
1:09 a. m.	65 10	1.10	1.366	.921	.728	.045	.071	.058	82.2	9.8	12.7	
0:15 a. m.	69 33	1.06	1.361	.916	.718	.032	.042	.037	81.8	9.6	9.2	
2:51 p. m.	49 03	1.32	1.292	.888	.698	.041	.053	.047	81.5	13.0	11.0	
June 2												
3:07 a. m.	46 18	1.38	1.250	.857	.688	.064	.098	.081	75.3	13.0	11.0	N_{PC}
June 7												
3:02 a. m.	47 31	1.35	0.928	.672	.544	.185	.195	.190	62.1	12.5	10.7	N_{PC}becoming T_M
4:17 p. m.	33 47	1.79	.844	.625	.512	.152	.149	.150	60.3	15.4	8.3	
June 12												
1:34 a. m.	62 37	1.12	1.047	.748	.614	.199	----------	.199	65.7	5.0	10.2	N_{PC}
0:29 a. m.	69 58	1.06	1.130	.797	.640	.160	.179	.170	69.9	9.8	12.4	
3:21 p. m.	44 23	1.43	1.109	.782	.637	.113	.154	.134	67.4	8.4	9.5	
June 13												
3:22 a. m.	44 13	1.43	1.095	.795	.635	.148	.115	.132	67.7	8.5	9.6	N_{PC}; T_A Aloft
2:54 a. m.	48 18	1.33	1.075	.770	.620	.141	.152	.146	67.6	10.4	10.5	
1:28 a. m.	70 20	1.06	1.125	.792	.625	.200	.194	.197	67.3	7.5	12.5	
4:49 a. m.	28 12	2.11	.989	.730	.602	.113	.128	.120	60.1	7.5	6.3	
June 14												
0:30 a. m.	70 30	1.06	1.356	.911	.715	.045	.073	.059	82.5	13.5	13.7	N_{PC}
4:40 p. m.	29 52	2.00	1.158	.814	.643	.041	.070	.056	72.9	11.3	7.9	
June 17												
4:42 a. m.	29 54	2.00	.807	.609	.495	.181	.156	.168	54.7	11.8	7.1	N_Y
3:12 a. m.	46 09	1.39	.990	.718	.569	.101	.143	.122	69.6	16.9	10.7	
June 23												
4:00 a. m.	37 23	1.64	1.084	.777	.626	.091	.100	.096	69.6	11.9	8.7	N_{PC}
3:21 a. m.	44 34	1.42	1.104	.787	.629	.103	.120	.112	70.7	11.9	10.0	
2:58 a. m.	48 41	1.33	1.124	.790	.639	.118	.150	.134	69.1	9.3	10.4	
1:41 a. m.	69 25	1.07	1.198	.824	.653	.150	.162	.156	71.1	7.3	12.4	
June 24												
4:52 a. m.	27 46	2.14	1.075	.825	.632	.064	.014	.039	75.0	17.7	7.0	N_Y
2:55 a. m.	42 20	1.48	1.250	.870	.685	.045	.050	.048	79.4	11.9	9.7	
June 26												
4:58 a. m.	26 38	2.23	1.190	.848	.675	.032	.032	.032	77.1	13.7	6.5	N_Y
June 27												
2:59 a. m.	48 31	1.33	1.108	.788	.629	.120	.135	.128	75.1	16.0	10.7	T_S
3:17 p. m.	35 14	1.73	1.050	.737	.606	.101	.152	.126	64.1	9.1	7.9	
3:15 p. m.	23 30	2.50	.843	.636	.520	.114	.123	.118	56.0	11.1	5.6	
June 28												
4:12 a. m.	35 05	1.74	1.100	.785	.630	.081	.100	.090	69.3	10.7	8.0	N_Y
2:59 a. m.	48 31	1.33	1.225	.840	.668	.078	.100	.089	75.0	9.7	10.4	
0:16 a. m.	70 49	1.06	1.307	.886	.700	.109	.195	.152	71.9	2.2	9.6	
June 30												
4:43 a. m.	28 17	2.10	.775	.600	.500	.183	.181	.182	51.0	9.7	6.6	T_A & N_Y; change at 8 a. m.
3:00 a. m.	48 15	1.34	.931	.678	.552	over .200	over .200	over .200	61.0	11.4	10.6	
3:24 p. m.	43 52	1.44	1.061	.744	.606	.181	.176	.178	64.6	8.1	9.4	

Atmospheric conditions during solar radiation measurements. Blue Hill Observatory of Harvard University

Date and time from apparent noon	Air temperature	Wind Beaufort scale	Visibility (scale 0–10)	Sky-blueness	Cloudiness and remarks
June 1935	° *C.*				
1; 4:08 p. m.	13.9	NNE 4	8-9	10	3 Acu, few Cu.
2; 3:18 a. m.	16.7	NE 4	9	10	Few Cu.
2; 0:33 a. m.	19.4	E 3	8-9	10	Few Ci, 1 Cu, light haze.
2; 2:35 p. m.	20.0	NE 3	9	9	3 Ci, few Cu.
7; 3:18 a. m.	16.1	W 2	6	7	3 Ci, light fog and heavy water haze.
7; 2:22 p. m.	22.8	S 5	8	7	2 Acu, 3 Cu, heavy water haze.
7; 4:00 p. m.	21.7	S 5	8	8	Few Ci, few Cu, heavy water haze
12; 3:27 a. m.	18.9	SW 2	7	6	5 Acu, Cu, Stcu, mod. water haze.
12; 0:45 a. m.	23.3	W 3	7	6	Few Acu, few Cu, mod. water haze.
12; 3:04 p. m.	23.3	W 5	8	9	3 Cu, mod. water haze.
13; 3:17 a. m.	19.4	W 1	7	9	3 Acu, few Cu, heavy water haze.
13; 0:38 a. m.	28.9	S 2	8	7	5 Cu, heavy water haze.
13; 2:27 p. m.	28.9	WNW 3	8	7	6 Cu, mod. water haze.
13; 4:23 p. m.	27.2	W 3	8	9	3 Cu, light water haze.
17; 3:15 a. m.	21.1	SW 5	8	8	10 Cist, very thin, mod. haze.
22; 3:13 a. m.	22.2	S 5	8	8	6 Acu Cu, light water haze.
23; 4:41 a. m.	15.6	W 4	8	10	Few Acu, light haze.
23; 3:15 a. m.	21.7	W 3	8	9	1 Acu, light haze.
23; 2:36 p. m.	25.0	SW 4	8	8	2 Acu, 3 Cu, light haze.
24; 3:19 a. m.	18.3	WNW 4	8	10	Few Ci, few Cu, light haze.
24; 0:36 a. m.	26.1	W 3	8	9	Few Ci, 6 Cu, light haze.
27; 3:16 a. m.	21.7	S 3	8	9	1 Ci, 2 Acu, heavy haze.
27; 0:01 p. m.	26.1	S 4	8	8	3 Ci, 3 Cu, mod. haze.
27; 2:55 p. m.	26.1	S 6	8	7	3 Ci, mod. haze.
28; 3:18 a. m.	21.7	W 1	7	9	4 Ci, mod. haze.
28; 0:35 a. m.	27.2	N 2	8	9	4 Ci, few Cu, light haze.
30; 3:22 a. m.	22.2	SSW 3	7-8	9	No clouds, heavy haze.
30; 2:20 p. m.	28.9	W 4	8	6	6 Cu, light haze.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy, Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measure from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time	Heliographic: Diff. in longitude	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day	Observatory
1935	h. m.	°	°	°				
June 1	11 15	−44.0	278.8	+26.0		62		U. S. Naval.
		−8.0	311.8	−30.5		185	247	
June 2	10 36	−31.0	276.0	+27.0		62		Do.
		+6.0	313.0	−30.5		340	402	
June 3	12 40	−21.0	271.5	+28.0	17			Mount Wilson.
		+20.0	312.5	−30.0		691	708	
June 4	12 15	−87.0	192.6	+28.0	100			Do.
		−8.0	271.6	+27.0	4			
		+31.0	310.6	−30.0		496		
		+80.0	359.6	−26.0	18		618	
June 5	11 4	−70.0	197.0	+28.0		62		U. S. Naval.
		+46.0	313.0	−31.0		340	402	
June 6	11 39	−59.0	194.5	+29.0		85		Do.
		+58.0	311.5	−31.0		278	363	
June 7	11 3	−48.0	192.5	+29.0		62		Do.
		+70.0	310.5	−31.5		247	309	
June 8	12 55	−64.0	162.2	−27.0		66		Mount Wilson.
		−49.0	177.2	+28.5		11		
		−32.0	194.2	+28.0	100			
		−19.0	207.2	−32.0		109		
		+85.0	311.2	−30.0		40	326	
June 9	14 1	−44.0	168.4	−26.0		77		U. S. Naval.
		−41.5	170.9	−36.0		31		
		−18.0	194.4	+29.0		60		
		−4.0	208.4	−31.5		247	424	
June 10	11 38	−30.0	170.5	−26.0		46		Do.
		−30.5	170.0	−35.0		39		
		−25.0	175.5	+27.0		39		
		−20.0	180.5	+26.0	15			
		−8.0	192.5	+28.5		39		
		+9.0	209.5	−31.0		247	425	
June 11	12 0	−54.0	133.1	+29.0		86		Mount Wilson.
		−19.0	168.1	−25.0		8		
		−19.0	168.1	−35.0		41		
		−5.0	182.1	+27.0	4			
		+9.0	196.1	+28.0	8			
		+22.0	209.1	−32.0		205	352	
June 12	11 0	−42.0	132.4	+30.0		62		U. S. Naval.
		+4.5	178.9	+28.0		62		
June 13	11 10	+35.0	209.4	−30.5		154	278	
		−29.0	132.1	+29.5		93		Do.
		+18.0	179.1	+28.0		69		
		+46.0	207.1	−30.0		62	224	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic: Diff. in longitude	Heliographic: Longitude	Heliographic: Latitude	Area: Spot	Area: Group	Total area for each day	Observatory
1935	h. m.	°	°	°				
June 14	11 9	−17.5	130.3	+29.5		93		U. S. Naval.
		+37.0	184.8	+27.0	31			
		+60.0	207.8	−30.0		46	170	
June 15	10 36	−71.0	63.9	−20.0	93			Do.
		−63.0	71.9	+16.0		62		
		−5.0	129.9	+29.5		31		
		+48.0	182.9	+27.0		31		
		+70.0	204.9	−31.0	8		225	
June 16	12 54	−64.0	56.4	−19.0		139		Do.
		−43.0	77.4	+15.0	46			
		+9.0	129.4	+29.5	23			
		+61.0	181.4	+27.0		93	301	
June 17	11 7	−86.0	22.1	−19.0	31			Do.
		−51.0	57.1	−19.0		108		
		−29.5	78.6	+15.0		31		
		+69.5	177.6	+27.5	46		216	
June 18	11 12	−70.0	24.9	−19.5	93			Do.
		−36.0	58.9	−19.5		123		
		−14.0	80.9	+14.0	31		247	
June 19	12 0	−59.0	22.2	−19.5	226			Mount Wilson.
		−25.0	56.2	−19.0		260		
		−2.0	79.2	+15.0		39	525	
June 20	11 8	−44.5	23.9	−19.0	123			U. S. Naval.
		−17.5	50.9	−17.5		31		
		−10.0	58.4	−19.5		123		
		+10.5	78.9	+15.0		31	308	
June 21	8 45	−59.5	357.0	−28.0	8			Mount Wilson.
		−31.0	25.5	−19.5		249		
		−1.0	55.5	−17.0		54		
		+25.0	81.5	+15.0	4			
		+59.5	116.0	+31.0		18	333	
June 22	11 0	−18.0	24.0	−19.5	123			U. S. Naval.
		+47.0	89.0	+15.0	31		154	
June 23	10 58	−80.0	308.8	−24.5	154			Do.
		−5.0	23.8	−19.5	154			
		−6.0	22.8	−20.0	10		318	
June 24	11 12	−69.0	306.4	−26.0		432		Do
		+8.5	23.9	−19.5	123		555	
June 25	11 11	−61.0	301.2	−30.0		31		Do.
		−55.0	307.2	−24.5		586		
		+22.0	24.2	−19.5	123		740	
June 26	11 8	−49.0	300.0	−31.0		39		Do.
		−42.0	307.0	−25.0		648		
		+35.0	24.0	−19.5	139		826	
June 27	11 4	−37.5	298.3	−31.0		39		Do.
		−30.0	305.8	−24.5		617		
		+49.0	24.8	−19.5	139		795	
June 28	11 4	−23.0	299.6	−30.5		62		Do.
		−21.0	301.6	−22.0	93			
		−16.0	306.6	−24.0		617		
		+61.0	23.6	−19.5	123		895	
June 29	10 37	−10.5	299.1	−31.0		31		Do.
		−9.0	300.6	−22.0		93		
		−4.0	305.6	−24.0		556		
		+73.0	22.6	−19.5	69		749	
June 30	13 0	+3.0	298.0	−29.0		30		Mount Wilson.
		+11.0	306.0	−24.0		956	986	
Mean daily area for 30 days.							447	

PROVISIONAL SUN-SPOT RELATIVE NUMBERS FOR JUNE 1935

[Dependent alone on observations at Zurich and its station at Arosa]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen, Sternwarte, Zurich, Switzerland]

June 1935	Relative numbers	June 1935	Relative numbers	June 1935	Relative numbers
1	34	11	*Ec* 74	21	50
2	*b* 39	12	66	22	*a* 35
3	34	13	55	23	*d* 29
4	34	14	41	24	*a* 38
5	*d* 31	15	*d* 49	25	44
6	41	16	42	26	51
7	25	17	38	27	56
8	*Ec* 46	18	*d* 41	28	52
9	*Ec* 60	19	38	29	45
10	*b* 73	20	67	30	*b* 42

Mean, 30 days = 45.7.

a = Passage of an average-sized group through the central meridian.
b = Passage of a large group or spot through the central meridian.
c = New formation of a center of activity: *E*, on the eastern part of the sun's disk; *W*, on the western part; *M*, in the central circle zone.
d = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in Charge]

By L. T. SAMUELS

Airplane observations were not made at Boston during June. They were begun at Barksdale Field, Shreveport, La., on June 15, and discontinued at Spokane by the National Guard on June 8.

At those stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during June averaged below normal, except in the higher levels at Norfolk and San Diego. (See table 1.) The lowest average upper-air temperatures occurred at Seattle and Spokane. Upper-air relative humidities averaged above normal in practically all cases with small to moderate departures. The relative humidities in the highest levels averaged greatest over Billings and Oklahoma City and lowest over San Diego.

The resultant winds for the month were in general as follows: At the 2,000 and 4,000-meter levels, the directions were close to normal and the velocities mostly above normal, with extremely large departures in the latter over the Middle Mississippi and Ohio River Valleys and extreme Northwest.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during June 1935*

TEMPERATURE (° C.)

Stations	Altitude (meters) m. s. l.																		Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Barksdale, La.[3] (52 m)	22.7	-------	23.9	-------	20.9	-------	18.4	-------	15.9	-------	12.7	-------	9.8	-------	3.5	-------	−2.6	-------	16
Billings, Mont.[1] (1,088 m)	11.7	-------	-------	-------	-------	-------	14.6	-------	12.2	-------	8.6	-------	5.0	-------	−1.9	-------	−8.5	-------	30
Cheyenne, Wyo.[1] (1,873 m)	9.5	-------	-------	-------	-------	-------	-------	-------	10.8	-------	11.4	-------	8.5	-------	1.0	-------	−7.1	-------	30
Fargo, N. Dak.[1] (274 m)	12.0	-------	13.5	-------	12.8	-------	10.0	-------	7.1	-------	4.1	-------	1.4	-------	−4.2	-------	−10.4	-------	30
Kelly Field (San Antonio), Tex.[2] (206 m)	22.7	-------	22.7	-------	20.7	-------	18.4	-------	15.8	-------	12.8	-------	9.8	-------	2.5	-------	−4.3	-------	27
Lakehurst, N. J.[3] (3 m)	18.3	-------	19.4	-------	17.5	-------	15.0	-------	11.8	-------	9.2	-------	7.1	-------	2.9	-------	−1.6	-------	25
Maxwell Field (Montgomery), Ala.[2] (52 m)	21.5	-------	22.6	-------	19.8	-------	16.3	-------	13.3	-------	10.2	-------	7.3	-------	1.1	-------	−4.6	-------	28
Mitchel Field (Hempstead, L. I.), N. Y.[2] (29 m)	16.1	-------	17.5	-------	15.3	-------	12.8	-------	9.8	-------	7.0	-------	4.7	-------	0.0	-------	−6.1	-------	27
Murfreesboro, Tenn.[1] (174 m)	17.9	-------	20.0	-------	17.8	-------	15.0	-------	12.2	-------	9.3	-------	6.6	-------	0.5	-------	−5.1	-------	30
Norfolk, Va.[3] (10 m)	21.1	−1.7	21.5	−0.1	20.2	+0.7	17.5	+0.9	14.4	+0.9	11.2	+0.5	8.7	+0.7	3.7	+0.7	−1.0	+0.7	27
Oklahoma City, Okla.[1] (391 m)	19.4	-------	19.9	-------	19.4	-------	17.3	-------	14.9	-------	12.1	-------	9.0	-------	1.8	-------	−5.4	-------	30
Omaha, Nebr.[1] (300 m)	15.9	−2.9	16.9	−3.3	16.7	−4.2	13.9	−4.4	11.1	−4.2	7.9	−3.8	4.8	−3.3	−1.3	−2.7	−7.5	−2.2	30
Pensacola, Fla.[3] (24 m)	23.1	−1.7	22.7	−0.4	19.3	−1.0	15.9	−1.6	13.3	−1.3	10.3	−1.5	7.3	−1.6	1.3	−1.9	−4.5	−1.9	30
San Diego, Calif.[3] (10 m)	16.8	−2.2	13.8	−1.9	18.1	+1.0	22.0	+4.2	20.2	+2.9	17.4	+2.8	14.2	+2.6	8.1	+2.8	0.7	+2.8	30
Scott Field (Belleville), Ill.[3] (135 m)	16.8	-------	19.6	-------	17.8	-------	14.9	-------	11.9	-------	8.9	-------	6.4	-------	1.2	-------	−4.4	-------	29
Seattle, Wash.[3] (25 m)	12.6	−2.7	11.2	−1.1	9.3	−0.5	6.6	−0.7	4.2	−0.6	2.2	−0.3	0.0	−0.1	−5.0	−0.4	−10.8	−0.5	30
Selfridge Field (Mount Clemens), Mich.[3] (177 m)	14.3	-------	15.9	-------	13.4	-------	10.1	-------	7.3	-------	4.5	-------	2.1	-------	−3.2	-------	−9.2	-------	28
Spokane, Wash.[4] (596 m)	16.0	-------	-------	-------	14.4	-------	11.6	-------	8.4	-------	4.7	-------	1.6	-------	−4.7	-------	−11.0	-------	8
Sunnyvale, Calif.[3] (10 m)	16.9	-------	15.6	-------	18.3	-------	19.0	-------	16.8	-------	14.1	-------	11.2	-------	4.4	-------	−3.3	-------	23
Washington, D. C.[3] (13 m)	17.7	−4.1	18.6	−1.6	17.1	−1.0	14.2	−1.2	10.8	−1.7	7.6	−1.7	4.8	−2.1	−0.1	−1.1	−5.4	−0.4	25
Wright Field (Dayton), Ohio[3] (244 m)	15.1	-------	17.3	-------	15.6	-------	12.4	-------	9.4	-------	6.9	-------	4.3	-------	−1.2	-------	−7.1	-------	30

RELATIVE HUMIDITY (PERCENT)

Barksdale, La.	87	-------	66	-------	68	-------	61	-------	52	-------	47	-------	41	-------	48	-------	41	-------	-------
Billings, Mont.	71	-------	-------	-------	-------	-------	53	-------	51	-------	55	-------	59	-------	60	-------	55	-------	-------
Cheyenne, Wyo.	81	-------	-------	-------	-------	-------	-------	-------	71	-------	50	-------	45	-------	43	-------	45	-------	-------
Fargo, N. Dak.	85	-------	73	-------	63	-------	64	-------	64	-------	65	-------	59	-------	45	-------	38	-------	-------
Kelly Field (San Antonio), Tex.	96	-------	88	-------	77	-------	69	-------	63	-------	59	-------	56	-------	56	-------	50	-------	-------
Lakehurst, N. J.	83	-------	61	-------	60	-------	63	-------	64	-------	62	-------	52	-------	43	-------	34	-------	-------
Maxwell Field (Montgomery), Ala.	83	-------	64	-------	59	-------	59	-------	57	-------	53	-------	52	-------	49	-------	42	-------	-------
Mitchel Field (Hempstead, L. I.), N. Y.	92	-------	72	-------	73	-------	71	-------	71	-------	68	-------	63	-------	51	-------	43	-------	-------
Murfreesboro, Tenn.	88	-------	69	-------	68	-------	70	-------	68	-------	61	-------	55	-------	53	-------	51	-------	-------
Norfolk, Va.	86	+10	74	+6	67	+4	67	+5	70	+9	72	+14	66	+12	58	+12	48	+12	-------
Oklahoma City, Okla.	88	-------	81	-------	69	-------	64	-------	61	-------	56	-------	55	-------	55	-------	56	-------	-------
Omaha, Nebr.	89	+8	78	+7	64	+8	60	+6	59	+8	57	+6	54	+3	52	+4	45	+3	-------
Pensacola, Fla.	84	+3	74	−1	72	+2	69	+1	63	−2	60	−1	58	+1	53	+2	53	+6	-------
San Diego, Calif.	84	+12	91	+12	61	+3	33	−6	25	0	22	+1	20	+2	17	+2	14	+2	-------
Scott Field (Belleville), Ill.	92	-------	69	-------	65	-------	66	-------	69	-------	68	-------	63	-------	55	-------	50	-------	-------
Seattle, Wash.	79	+7	77	+3	74	0	73	+1	72	+2	68	+3	63	+4	54	+4	50	+4	-------
Selfridge Field (Mount Clemens), Mich.	87	-------	65	-------	65	-------	71	-------	69	-------	66	-------	58	-------	42	-------	41	-------	-------
Spokane, Wash.	43	-------	-------	-------	45	-------	48	-------	49	-------	48	-------	46	-------	46	-------	41	-------	-------
Sunnyvale, Calif.	73	-------	72	-------	54	-------	41	-------	36	-------	32	-------	30	-------	28	-------	28	-------	-------
Washington, D. C.	87	+17	72	+8	68	+7	68	+7	71	+9	71	+12	63	+8	53	+5	46	+7	-------
Wright Field (Dayton), Ohio	80	-------	73	-------	68	-------	69	-------	65	-------	56	-------	51	-------	46	-------	38	-------	-------

[1] Weather bureau. [2] Army. [3] Navy. [4] National Guard.

Observations taken about 5 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on "normals" covering the following number of observations made during the same month in previous years, including the current year: Norfolk, 141; Omaha, 120; Pensacola, 187; San Diego, 144; Seattle, 61; Sunnyvale, 65; Washington, 202.

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during June 1935*

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (189 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	335	1.0	313	0.7	305	1.9	278	1.1	264	2.6	211	1.3	180	0.2	242	1.2	238	1.5	122	1.1	135	1.8	287	0.6	195	1.3
500	------	------	292	1.6	------	------	287	6.7	------	------	241	4.3	240	4.2	256	3.7	268	3.2	181	6.8	138	3.1	295	1.2	220	3.4
1,000	------	------	270	3.1	------	------	284	3.9	------	------	249	5.0	254	6.8	251	5.9	288	4.8	179	7.3	140	2.3	296	2.1	243	5.6
1,500	------	------	267	3.9	306	3.0	278	4.9	------	------	259	5.6	262	6.9	263	6.1	296	5.9	178	6.8	149	1.4	280	0.8	250	5.8
2,000	246	1.1	260	5.0	288	3.5	274	6.8	246	3.9	264	6.4	263	8.1	264	6.8	293	7.1	188	6.0	169	1.1	296	1.8	248	6.2
2,500	275	3.6	265	5.7	281	5.1	271	7.9	245	5.1	262	7.2	263	8.9	261	7.3	284	7.6	192	4.8	184	0.7	270	3.6	255	5.9
3,000	293	5.1	261	5.2	280	7.3	267	8.7	275	6.4	267	8.5	261	9.5	263	7.3	279	9.3	190	2.9	197	0.4	257	5.2	271	5.6
4,000	299	5.3	281	6.6	279	11.7	256	7.6	287	11.0	------	------	251	11.0	288	7.0	302	13.2	194	2.0	284	0.8	263	8.2	286	3.7
5,000	281	3.4	265	6.4	290	15.2	------	------	287	12.0	------	------	------	------	282	7.8	303	15.1	273	2.0	268	3.8	256	9.8	------	------

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii[1] (68 m)		Pensacola, Fla.[1] 24 (m)		St. Louis, Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	318	0.6	222	0.4	187	3.0	177	0.7	53	2.6	316	0.8	221	1.8	152	2.5	197	0.8	275	0.3	151	1.4	109	0.6	282	0.5
500	293	4.2	277	1.8	191	5.3	225	2.1	73	6.2	238	0.8	238	5.4	------	------	237	1.2	269	1.5	227	1.5	------	------	290	3.9
1,000	278	6.1	320	5.5	214	10.8	261	4.8	67	4.4	223	2.2	255	6.6	------	------	------	------	256	2.9	236	2.5	218	2.6	289	5.0
1,500	277	6.8	338	3.9	233	8.4	269	5.5	73	6.1	218	2.7	268	7.9	166	2.3	------	------	250	4.2	229	4.0	252	3.4	279	5.9
2,000	280	8.0	330	3.2	241	8.7	278	6.6	69	5.7	271	2.0	270	9.4	264	1.0	------	------	260	5.1	233	4.8	254	4.5	269	8.4
2,500	272	8.7	318	4.7	263	7.8	283	7.3	49	3.1	298	1.4	280	8.9	285	2.5	------	------	265	5.6	249	4.9	254	5.2	271	8.9
3,000	283	7.0	307	4.6	276	5.1	296	8.5	62	3.2	313	2.2	276	8.7	290	4.6	------	------	291	4.4	255	6.3	260	6.2	267	8.5
4,000	------	------	307	6.1	303	5.5	------	------	------	------	342	3.6	------	------	275	9.0	------	------	299	8.5	272	7.7	277	8.8	278	8.7
5,000	------	------	------	------	------	------	------	------	------	------	------	------	------	------	270	14.6	------	------	303	10.7	------	------	271	6.0	------	------

[1] Navy stations.

RIVERS AND FLOODS

[River and Flood Division, MONTROSE W. HAYES, in charge]

By RICHMOND T. ZOCH

The most disastrous floods during June were those in the Missouri Basin and in the Colorado, Guadalupe, and Nueces Rivers of Texas.

Exceptionally heavy rains on May 31 and June 1 over the Republican River Valley caused a very destructive flood throughout the length of this river in both Nebraska and Kansas. The next paragraph gives an account of the damage in the State of Nebraska; following it the report of the official in charge, Weather Bureau office, Topeka, Kans., is quoted, and the effects of the flood in Kansas are described.

About 250,000 acres of land in Nebraska were flooded, forming a strip along the river throughout its length in the State (210 miles) and from 1 to 3 miles wide. One hundred and four persons were drowned, more than 1,000 families were made homeless and the buildings on more than 600 farms were washed away. Two hundred and thirteen miles of railway tracks were also washed away. This flood was the worst in Nebraska since the coming of the white man, and the total property damage has been estimated at $13,000,000. Needless to say, the highest stage of record was reached at Guide Rock, Nebr., which is the uppermost river gage maintained by the Weather Bureau on the Republican River.

Floods were caused by the same storm in the South Platte, North Platte, and Nemaha Rivers of Nebraska, but they were not serious.

Besides the flood in the Republican River, there were severe floods in the other rivers of the Kansas system in Kansas. The highest stages of record were reached at the following river gage stations: Scandia, Concordia, Manhattan, and Beloit (all in the Kansas River Basin in Kansas). Six persons were drowned by these floods. The official in charge, Weather Bureau office, Topeka, Kans., comments as follows on the floods in the Kansas River Valley:

The Republican flood the first 3 days of the month, the worst in the State, moved very rapidly and swept away nearly all bridges and many small buildings in its patch. Total area overed by it was estimated at 125 square miles, and the damage, exclusive of that to railroads, was estimated at $2,451,600, of which almost a million dollars was to highways, bridges, and buildings. A second and smaller overflow of the Republican on the 19th–21st caused little additional damage.

The Solomon River overflowed a large area in the vicinity of Beloit, reaching the record-breaking crest on the 3d and lesser crests on the 19th and 29th. Two overflows occurred at Niles. Total damage along this stream was placed at $477,575. The Smoky Hill overflowed four times at Lindsborg, reaching crests on the 5th, 16th, 21st, and 30th. At Salina it overflowed slightly on the 23d and at Enterprise on the 8th–10th. Total damaged was estimated at $263,500.

The crest of the Republican connected very closely with the crest of a rather serious overflow at the Blue at Manhattan and resulted in a stage at that place that slightly exceeded the great overflow of 1903. This crest tended to flatten out as it moved down the Kansas Valley. It approximated the 1908 highwater marks at Wamego and Topeka and fell below them at Lawrence

and points farther down. Total damage in the Kansas River Valley proper, exclusive of that to railroads, was estimated at $1,392,100, the largest single loss being to prospective crops, 112,500 acres being flooded. This loss would probably have been twice as great had not timely warnings made it possible to hold the dyke system at Topeka, preventing serious flooding of any part of the city. Damage to railroads in the Kansas Basin exceeded half a million dollars.

Concerning the floods in the Grand, Osage, and lower Missouri Rivers in May and June the official in charge, Weather Bureau Office, St. Louis, Mo., writes as follows:

Flood conditions began in the Grand about May 20. In the upper reaches there were some ups and downs between May 20 and the end of the month, but in the lower reaches, at Brunswick, flood stage was first passed on May 21 and there was no below-flood-stage reading until June 16. A peculiarity of the whole flood season in the Grand was the fact that Thompson's Fork did not have bankful stage at all, the highest stage recorded on the Weather Bureau's gage at Trenton being 19.82 feet, on June 1, which is 0.18 foot below flood stage. Gallatin had a 1-day flood (22.1 feet) on May 21, and on May 29 a fairly strong flood, with crest at 25.14 feet, which was followed by a fall, May 30 to June 1, and then the chief crest came on June 4, 32.92 feet. This was followed by generally falling until June 16, when another rise began which brought a crest of 22.56 on the 19th. It then fell rapidly.

At Chillicothe, the first flood occurred, beginning May 20 and reaching crest of 26.7 May 22; then fell to 12.0 feet by May 27. The main flood at Chillicothe began on May 28 and continued until June 7, with crest of 29.55 feet on June 3, except that there was a slight recession during May 30 to June 1. This was the highest water at Chillicothe since 1931. The nighest stage of record at Chillicothe, 1915 to date, was 32.1 feet in June 1929. (A crest of 33.65 feet is said to have been reached in July 1909.) At Brunswick, the crest, 20.5 feet on June 5, 1935, was the highest stage recorded since July, 1909, when a crest of 23.0 feet is said to have occurred. Other principal crests at Brunswick were: in 1917, 19.4 feet; in 1929, 19.4 feet; in 1931, 18.9 feet.

This was, therefore, a major flood in the Grand, and, as usual when such strong overflows occur, much damage was done to crops and land and other property. Floods come suddenly in the upper and middle reaches of the Grand. The lowlands are mostly very fertile and produce fine crops and livestock. Flood warnings are essential and are highly valued by the people, and probably no part of the St. Louis River district derives more help from flood warnings than the Grand River Valley, and this is due largely to the fine cooperation the Weather Bureau receives in the distribution of warnings.

Mr. R. W. Benecke, of Brunswick, wrote this office June 24, 1935, and in his letter he made the following statement: "We have talked with many people, farmers living in the various parts of the flooded territory, railroad men, township road men, etc., and in every case these people state that it was due entirely to the forecasts of the Bureau telling of the probable height of the water that enabled property owners to move stock and movable goods to safety, and that practically no livestock was lost, only chickens, which after being wet would chill and die."

Since the completion of the dam at Bagnell on the Osage River, a few miles above Tuscumbia, in 1931, the stages at Tuscumbia have been affected by the operations at the dam, so that the crest in the recent flood at Tuscumbia may not be strictly comparable with the records in 1929 and preceding years. But it is understood that the crest of 36.8 feet, June 4, 1935, at Tuscumbia occurred under approximately natural flow of the river, since the Lake had been filled several days before, June 4, and it is assumed that the water that came down from Osceola and entered the Lake flowed on through to Tuscumbia without hindrance. The flooded crests of 1927, 1929, and 1935, bear pretty uniform relations; that is, 30.4 at Osceola in 1927 gave 36.8 at Tuscumbia; 30.6 at Osceola in 1929 gave 36.9 Tuscumbia; and 29.4 at Osceola in 1935 gave 36.8 at Tuscumbia and 29.4 at Osceola in 1935 gave 36.8 at Tuscumbia. The crest was relatively strong at Tuscumbia in 1935, it seems, say about 1.0 foot higher, relatively, than in 1927 and 1929. There may be good reasons for this, such as distribution of rainfall, the high stage of the Missouri at the mouth of the Osage, etc., or, it might be due to the greatly widened river (the Lake) a few miles above Tuscumbia.

The distinctive feature of the flood in the lower Missouri River—light at Kansas City, moderate at Waverly, increasing strongly below the mouth of the Grand River, and still more strongly below the mouth of the Osage, and reaching a height at St. Charles and below that has been exceeded only once in the history of authentic records—is well shown by the following table.

Station	Crest	Above bankful
	Feet	*Feet*
Kansas City	23.9	1.9
Waverly	22.02	4.0
Boonville	26.71	5.7
Hermann	28.8	7.8
St. Charles	35.1	10.1

Another marked feature was the long duration of the period of above bankful stages, from Boonville to the mouth of the river, as shown by the following:

Number of days above flood stage

Year of flood	Kansas City	Waverly	Boonville	Hermann	St. Charles
	Days	*Days*	*Days*	*Days*	*Days*
1903	12	----------	13	14	----------
1908	27	----------	25	15	----------
1909	19	----------	11	11	----------
1915	28	12	26	11	----------
1917	11	6	7	8	----------
1922	0	0	0	13	15
1927	4	4	6	17	20
1929	4	9	6	8	11
1935	2	17	15	37	40

This long-continued bankful period in this flood was caused by the continued rainy weather of June 10 to 21, which did not increase the crests, but retarded the fall.

The crests of the principal floods in the lower Missouri River during the last 40 years are given in the following table:

Date	Kansas City crest	Waverly crest	Boonville crest	Hermann crest	St. Charles crest
1903, June	34.95	----------	30.9	29.5	36.80
1905, July	23.0	----------	19.9	19.6	----------
1905, September	18.6	----------	22.0	25.7	----------
1908, June	30.3	----------	26.7	25.0	----------
1909, July	27.0	----------	26.8	26.1	----------
1915, May-June	25.2	18.1	24.6	25.9	----------
1915, June	27.0	19.7	22.5	23.5	----------
1915, July	29.0	20.9	25.0	24.3	----------
1917, June	26.7	19.6	23.9	24.8	----------
1922, April	21.5	16.4	18.3	24.7	30.5
1927, April	24.8	20.63	24.0	26.8	33.0
1929, June	23.4	20.0	23.7	24.8	31.3
1935, June	23.7	22.02	26.71	28.8	35.1

The Weather Bureau service was highly valued and appreciated. Mr. C. P. Owens, engineer of maintenance, State highway department, Jefferson City, Mo., wrote this office as follows: "In estimating the money value of property saved by flood warnings, we have taken into consideration only the actual damage that might have occurred had we not had ample warning; but I would like to call your attention to another phase that undoubtedly resulted in a considerable saving to the traveling public. Due to your cooperation we were able to broadcast and forecast quite accurately road information daily. People living in various parts of the State picking up this information were, undoubtedly, able to save themselves considerable trouble and expense and travel distance. This information enabled many people to avoid flooded areas and relieved us of considerable traffic congestion that might otherwise have occurred."

The Des Moines River in Iowa experienced its worst flood since 1917. Considerable damage and inconvenience resulted and more damage would have occurred but for the Weather Bureau's warnings. At Eddyville, Iowa, 100 men used 14,000 bags of sand to raise the levee about 3 feet. Had the water risen 4 inches higher it would have passed over this barrier and flooded all but 23 houses in a town of 850 inhabitants.

The upper Mississippi River from Keokuk, Iowa, to Cairo, Ill., had its greatest flood since 1939. The flood losses were comparatively light. However, at Alton, Ill., where the Government is having a dam built, the suspension of work and immense deposit of mud caused delay and heavy expense.

The official in charge, Weather Bureau office, Little Rock, Ark., reports as follows on the flood in the Arkansas River:

Nearly all levees above Little Rock gave way, inundating large areas and causing the crest at Little Rock to be much lower than expected, while the levees below Little Rock held, causing higher stages than were expected. The crest at Little Rock was 28.2, which was 4.8 feet lower than that of 1927, while the crest at Pine Bluff was given as 32.2 which is only 0.2 foot lower than the crest of 1927.

Heavy rains over the St. Francis Basin caused a flood there, with the highest stage of record for this time of the year. Undoubtedly still higher stages would have occurred if all the levee breaks caused by previous floods this year had been repaired.

There was a moderate flood in the Upper Trinity River in Texas. This flood was most severe on the East Fork of the Trinity River, where levees were overtopped and broken in many places.

The official in charge, Weather Bureau office, San Antonio, Tex., makes the following statements on the floods in the Colorado, Guadalupe and Nueces Rivers in Texas:

Heavy to excessive rains over the watersheds of the Colorado, Guadalupe, and Nueces Rivers from June 12 to 16 caused severe floods in these river systems. The highest stages known occurred at Marble Falls, Austin, and Smithville on the Colorado; and at New Braunfels and Victoria on the Guadalupe; also at Cotulla on the Nueces.

Timely warnings were issued for these floods, and large amounts of property saved thereby. Matured crops were gathered, livestock moved to high ground, and furniture, farm implements, and machinery were stored in high places. However, losses were heavy, especially to bridges and highways. Thousands of pecan trees were lost, and many farm buildings entirely disappeared. Eight people are known to have been drowned.

There were widespread rains on June 13 in the lower Rio Grande Valley. The heaviest 24-hour fall of record occurred at Del Rio, Tex., and a very rapid rise in the Rio Grande followed. The Rio Grande had previously reached the flood stage at Mercedes and Brownsville. The property damage was not heavy, but four persons were drowned when their home was washed away.

The floods in the colorado system (draining into the Gulf of California) and on the Pacific slope were of minor consequence.

Practically all the floods in the Mississippi system which have not been specifically mentioned above, but which are shown in the accompanying table, caused damage varying from slight to serious. However, even where extensive damage occurred no unusual feature was presented. Comments on the flood of June in the lower Mississippi River must be postponed pending its subsidence.

Table of flood stages during June 1935

[All dates are in June unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM					
Upper Mississippi Basin	*Feet*			*Feet*	
Rock: Moline, Ill.	10	30	30	10.0	30
Iowa: Iowa City, Iowa	8	26	29	8.6	26
Skunk: Augusta, Iowa	15	2	2	15.1	2
Des Moines:					
Tracy, Iowa	14	3	3	15.2	3
		19	20	15.6	20
		26	July 7	20.1	28
Ottumwa, Iowa	9	3	4	10.0	4
		19	21	10.4	20
		27	July 8	15.4	28

Table of flood stages during June 1935—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Illinois:	*Feet*			*Feet*	
Havana, Ill.	14	May 4	12	20.0	May 17
		19	(1)	15.3	July 6, 7
Beardstown, Ill.	14	May 3	16	22.4	May 17
		19	(1)	16.0	July 1, 2
Bourbeuse: Union, Mo.	12	23	24	16.0	23
		28	29	13.1	29
Meramec:					
Steelville, Mo.	12	21	21	20.4	21
		26	26	23.3	26
Pacific, Mo.	11	10	12	15.7	11
		21	26	21.5	24
		11	13	18.5	12
Valley Park, Mo.	14	21	26	24.8	24
		28	July 1	22.2	30
Mississippi:					
Keokuk, Iowa	12	2	2	13.9	2
Quincy, Ill.	14	3	5	16.0	3
Hannibal, Mo.	13	3	6	16.2	4
Louisiana, Mo.	12	7	7	15.9	4
		21	22	12.0	21, 22
Grafton, Ill.	18	2	13	22.6	7
Alton, Ill.	21	May 31	16	29.0	7
		23	26	22.3	25
St. Louis, Mo.	30	4	15	33.5	8, 9
Chester, Ill.	27	2	19	33.4	9
		21	27	29.1	26
Cape Girardeau, Mo.	32	4	19	36.4	11
		22	28	32.6	22, 23
Missouri Basin					
South Platte: North Platte, Nebr.	5	3	4	6.1	3
Saline: Tescott, Kans.	25	1	1	25.6	1
		3	6	29.4	3
		29	30	29.2	30
Solomon:					
Beloit, Kans.	18	1	5	34.5	3
		19	26	28.4	19
		28	29	21.0	29
Niles, Kans.	24	3	9	29.5	7
		24	25	26.2	25
Smoky Hill:					
Lindsborg, Kans.	21	5	5	21.5	5
		16	16	21.2	16
		20	22	25.3	21
		29	30	25.9	30
Salina, Kans.	20	23	23	20.5	23
Enterprise, Kans.	26	8	10	29.1	9
Republican:					
Guide Rock, Nebr.	11	1	3	24.0	1
		18	19	12.5	19
Scandia, Kans.	10	1	4	18.2	2
		19	20	11.5	19
Concordia, Kans.	8	1	5	17.0	2
		20	20	10.4	20
Clay Center, Kans.	12	1	5	25.7	3
		21	22	17.3	21
Blue:					
Beatrice, Kans.	16	2	2	16.7	2
Blue Rapids, Kans.	20	2	5	29.8	3
Randolph, Kans.	19	1	5	25.2	3
Kansas:					
Ogden, Kans.	18	2	7	28.0	3
Manhattan, Kans.	17	2	8	27.9	4
Wamego, Kans.	16	3	7	23.8	4
Topeka, Kans.	21	4	7	27.6	5
Lawrence, Kans.	18	5	7	22.1	6
Bonner Springs, Kans.	21	6	7	23.0	6
Grand:					
Gallatin, Mo.	20	May 28	5	32.9	4
		19	20	22.6	19
Chillicothe, Mo.	18	May 28	7	29.6	3
		17	21	26.9	20
		28	28	19.0	28
Brunswick, Mo.	12	May 21	15	20.5	5
		20	24	15.0	22
		27	July 6	14.6	July 4
Osage:					
Quenemo, Kans.	30	1	4	38.7	3
Ottawa, Kans.	24	1	5	32.0	3
La Cygne, Kans.	21	May 30	8	27.2	4
Osceola, Mo.	20	May 29	18	29.4	9
Tuscumbia, Mo.	25	May 29	19	36.8	4
		21	22	30.4	22
		27	27	30.4	27
St. Thomas, Mo.	20	May 29	23	32.9	4
		27	30	27.2	27
Missouri:					
Kansas City, Mo.	22	5	8	23.9	7
Waverly, Mo.	18	May 29	14	22.0	8
		29	July 4	18.9	3
Boonville, Mo.	21	May 30	13	26.7	5
Hermann, Mo.	21	May 30	25	28.8	6, 7
		27	July 5	23.8	29
St. Charles, Mo.	25	May 30	July 8	35.1	8

Table of flood stages during June 1935—Continued

River and station	Flood stage	Above flood stages—dates From—	Above flood stages—dates To—	Crest Stage	Crest Date
Ohio Basin					
	Feet			*Feet*	
Barren: Bowling Green, Ky.	20	22	24	25.9	23
Green:					
Lock No. 6, Brownsville, Ky.	28	22	26	34.5	24
Lock No. 4, Woodbury, Ky.	33	21	28	43.7	24
Lock No. 2, Rumsey, Ky.	34	22	July 4	40.5	29
Ohio:					
Dam No. 53, near Mound City, Ill.	42	May 17	1	46.3	May 26, 27
Cairo, Ill.	40	May 13	2	45.9	May 26
		10	14	40.8	12
		25	July 1	42.0	28
White Basin					
Black:					
Poplar Bluff, Mo.	14	23	24	15.7	23
		28	29	14.9	28
Black Rock, Ark.	14	2	(1)	22.4	19
White:					
		5	5	22.0	5
Cotter, Ark.	21	8	9	23.5	9
		18	21	25.5	20
		3	6	23.1	3
Calico Rock, Ark.	18	8	10	25.6	8
		17	21	28.4	18
		4	12	30.0	9
Batesville, Ark.	23	18	22	32.4	19
		6	15	29.7	11
Newport, Ark.	26	18	26	31.0	21
Georgetown, Ark.	21	May 7	July 9	27.7	24, 25
Clarendon, Ark.	26	May 11	(1)	32.0	28, 29
Arkansas Basin					
Little Arkansas: Sedgwick, Kans.	18	1	1	18.1	1
Cimarron: Perkins, Okla.	11	21	21	14.4	21
Verdigris: Sageeyah, Okla.	35	3	10	40.0	6
		18	21	37.1	20
Cottonwood: Emporia, Kans.	20	4	4	20.0	4
Neosho:					
Neosho Rapids, Kans.	22	3	5	25.8	4
LeRoy, Kans.	23	2	6	24.9	2
Iola, Kans.	15	2	5	17.6	3
Chanute, Kans.	20	1	8	24.5	1
		17	17	21.5	17
Parsons, Kans.	22	1	10	27.4	1
		17	18	22.4	1
		1	10	25.0	2
Oswego, Kans.	17	13	13	17.6	13
		16	19	20.4	18
Wyandotte, Okla.	23	7	9	27.7	8
Pensacola, Okla.	24	7	10	24.1	8
Fort Gibson, Okla.	22	1	11	31.1	9
		17	23	28.0	18
North Canadian:					
Canton, Okla.	6	2	2	6.0	2
Yukon, Okla.	8	3	4	8.7	4
Poteau: Poteau, Okla.	21	17	22	39.0	18
Petit Jean: Danville, Ark.	20	17	22	30.0	18
Arkansas:					
Wichita, Kans.	9	2	4	9.8	3
Arkansas City, Kans.	15	3	6	17.6	5
Webbers Falls, Okla.	23	2	12	28.8	9, 10
		17	24	29.9	18
Fort Smith, Ark.	22	2	13	29.0	9
		17	26	34.4	19
Van Buren, Ark.	22	2	13	29.4	10
		17	26	34.3	19
		5	6	22.6	6
Ozark, Ark.	22	9	12	24.7	11
		17	26	31.1	21
Dardanelle, Ark.	22	4	14	26.0	11
		17	27	29.5	21
Morrilton, Ark.	20	4	15	24.9	12
		17	28	29.2	22
Little Rock, Ark.	23	11	14	23.7	12
		18	28	28.2	23
Pine Bluff, Ark.	25	7	15	26.4	13, 14
		19	July 1	32.2	24
Red Basin					
Ouachita:					
Arkadelphia, Ark.	17	17	20	24.0	19
Camden, Ark.	26	20	26	33.0	23
Black: Jonesville, La.	30	May 9	(1)	51.9	May 22–29
Little: Whitecliffs, Ark.	25	20	28	28.6	22
Sulphur:					
Ringo Crossing, Tex.	20	16	24	31.4	17
Naples, Tex.	22	2	12	28.0	7
		19	30	29.7	21
Red:					
Arthur City, Tex.	27	17	18	31.7	17
Index, Ark.	25	18	27	30.7	22
Fulton, Ark.	25	18	30	34.8	24
Grand Ecore, La.	33	May 11	12	38.0	May 31
		26	(1)	(1)	(1)
Alexandria, La.	32	May 8	(1)	41.3	4

Table of flood stages during June 1935—Continued

River and station	Flood stage	Above flood stages—dates From—	Above flood stages—dates To—	Crest Stage	Crest Date
Lower Mississippi Basin					
Big Lake Outlet: Manila, Ark.	10	18	(1)	13.1	28, 29
St. Francis:					
Fisk, Mo.	20	13	29	23.8	24
St. Francis, Ark.	18	May 26	4	20.8	May 27
		17	(1)	22.8	21
Yazoo: Yazoo City, Miss.	29	Mar. 5	5	36.3	Apr. 11
Mississippi:					
New Madrid, Mo.	34	May 19	1	36.7	27, 28
Helena, Ark.	30	May 18	(1)	45.0	3
Arkansas City, Ark.	42	May 22	(1)	48.4	27–July 1
Greenville, Miss.	36	May 21	(1)	43.4	30–July 1
Vicksburg, Miss.	43	8	(1)	(1)	(1)
Natchez, Miss.	46	1	(1)	(1)	(1)
Angola, La.	45	May 31	(1)	(1)	(1)
Baton Rouge, La.	35	May 30	(1)	(1)	(1)
Donaldsonville, La.	28	5	(1)	(1)	(1)
Reserve, La.	22	8	(1)	(1)	(1)
Atchafalaya Basin					
Atchafalaya:					
Simmesport, La.	41	4	(1)	(1)	(1)
Melville, La.	37	May 20	(1)	(1)	(1)
Atchafalaya, La.	22	Mar. 15	(1)	(1)	(1)
WEST GULF OF MEXICO DRAINAGE					
Sabine: Logansport, La.	25	1	1	25.0	1
Neches: Beaumont, Tex.	7	1	2	7.4	1
Elm Fork: Carrollton, Tex.	6	15	18	9.3	16
Trinity:					
Dallas, Tex.	28	15	30	34.0	18
Trinidad, Tex.	28	18	30	40.6	23
Long Lake, Tex.	40	22	(1)	43.4	26
Liberty, Tex.	25	May 6	17	26.7	7
Colorado:					
Marble Falls, Tex.	21	15	16	[2] 39.5	15
Austin, Tex.	21	15	16	42.0	15
Smithville, Tex.	25	16	19	40.7	16
Columbus, Tex.	29	17	21	38.5	18
Wharton, Tex.	26	17	23	38.2	20
Guadalupe:					
New Braunfels, Tex.	20	15	16	35.0	15
Gonzales, Tex.	20	15	19	32.8	17
Victoria, Tex.	21	2	5	25.7	3
		15	22	29.6	20
Nueces:					
Cotulla, Tex.	15	17	23	31.0	19
		3	3	37.0	3
		6	8	39.8	7
Three Rivers, Tex.	37	13	18	44.7	15
		20	28	43.8	23
Rio Grande:					
Espanola, N. Mex.	7	17	18	7.0	17, 18
Del Rio, Tex.	15	14	15	23.6	14
Eagle Pass, Tex.	16	15	15	33.2	15
Laredo, Tex.	27	16	16	33.0	16
Riogrande, Tex.	21	17	18	27.4	18
Hidalgo, Tex.	21	18	20	22.8	19
Mercedes, Tex.	21	10	10	21.0	10
		17	21	22.5	20
		3	7	19.0	4
Brownsville, Tex.	18	10	11	19.3	10
		14	22	19.5	18
GULF OF CALIFORNIA DRAINAGE					
Eagle: Eagle, Colo.	5	12	17	5.9	15
Roaring Fork: Carbondale, Colo.	5	10	17	6.6	15, 16
		20	22	5.4	21
Gunnison:					
Sapinero, Colo.	19	13	16	19.5	15
Delta, Colo.	9	7	18	10.9	15, 16
		21	22	9.2	21
San Juan: Farmington, N. Mex.	7	16	17	7.2	17
Colorado: Grand Junction, Colo.	11	15	17	11.8	15
PACIFIC SLOPE DRAINAGE					
San Joaquin Basin					
Kings: Piedra, Calif.	10	4	8	10.4	
Columbia Basin					
Columbia: Vancouver, Wash.	15	May 29	27	17.9	11, 12

[1] Flood continued into July.

[2] This is the highest gage reading. The gage washed away, and it is estimated that the river reached 50.0 feet.

WEATHER OF THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, W. F. McDONALD in charge]

NORTH ATLANTIC OCEAN, JUNE 1935

By H. C. HUNTER

Atmospheric pressure.—The pressure averaged mostly below normal, and from near Ireland to Iceland much below. Valencia, Ireland, averaged almost a quarter-inch lower than normal, owing mainly to prevalence of almost continuous low pressure during the first fortnight. In some southeastern and northwestern areas the pressure averaged moderately greater than normal.

The extreme range of pressures noted by ships was from 28.94 to 30.54 inches, the lower reading being reported by the British S. S. *Samaria*, near 52° N., 33° W., on the 5th, while the higher reading came from the Italian liner *Conte di Savoia*, near 40° N., 36° W., on the 11th.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, June 1935*

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.78		30.23	12	29.10	22
Reykjavik, Iceland	29.77	−0.11	30.04	1, 25	29.10	21
Lerwick, Shetland Islands	29.82	+.02	30.29	29	29.16	8
Valencia, Ireland	29.76	−.24	30.28	28	29.10	7
Lisbon, Portugal	30.10	+.07	30.26	11, 15	29.94	22
Madeira	30.13	+.06	30.22	11, 19	30.00	22
Horta, Azores	30.23	−.01	30.50	30	29.97	18
Belle Isle, Newfoundland	29.98	+.14	30.34	6	29.60	16
Halifax, Nova Scotia	30.02	+.05	30.22	9	29.70	17
Nantucket	29.94	−.04	30.17	2	29.54	17
Hatteras	29.98	−.03	30.26	2	29.75	22
Bermuda	30.10	−.03	30.20	20, 21	29.96	4
Turks Island	30.01	−.02	30.09	20	29.93	10
Key West	29.98	−.01	30.07	2	29.87	10
New Orleans	29.98	.00	30.10	24	29.81	17

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans which are 24-hour corrected means.

Cyclones and gales.—Throughout the first week low pressure persisted over the waters just west of Ireland; and usually there was a well-marked center, with strong winds around it. About 20 different reports of gales have been received from this region; and on the 5th, near the 30th meridian, two steamers noted force 10 (whole gale). The center finally took a northeastward course and ceased to affect the steamship lanes.

The morning of the 10th found a well-defined low east of Delaware Bay near longitude 70° W., and the third instance (the last so far reported from North Atlantic waters) of force 10 was recorded on the 11th in connection with this storm; however, a northward course soon carried the center inland, and reports of gales due to its presence were but few.

On the morning of the 16th a vigorous storm was traveling eastward across Newfoundland, and during that day and the three succeeding days several vessels noted gales between the 50th and the 25th meridians. The storm took a more northerly course by the 18th; and by the 20th when near longitude 30° W. it had turned almost due north toward the waters just west of Iceland.

Fog.—There was much more fog than during May. The amount was somewhat less than normal for June near midocean and thence eastward to the 15th meridian along the chief steamship lanes; elsewhere to northward of the 40th parallel there was more than normal, and a very marked excess was found in North American waters from the St. Lawrence to Delaware Bay. The 5° square adjoining Maine and western Nova Scotia, 40°–45° N., 65°–70° W., led all others, having fog on 24 days; but the square next to eastward and the square 40°–45° N., 45°–50° W. had 23 days of fog. There were six other squares, near those just named, in each of which the record of fog exceeded 10 days.

Fog was the cause of 5 collisions and 4 groundings in various American waters from near Newfoundland to New York Bay. With one exception these occurred about the 7th of June or during the final 8 days of the month. The British steamship *Kafiristan* and one schooner were much damaged in two of the collisions, while the grounded British whaler *Deane* is probably a total loss. The chief tragedy reported was in Penobscot Bay, June 8; the small steamboat *Castine* struck on a ledge and later heeled over, resulting in death of 2 passengers and injury of 4.

OCEAN GALES AND STORMS, JUNE 1935

Vessel	Voyage		Position at time of lowest barometer		Gale began June—	Time of lowest barometer June—	Gale ended June—	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Queen of Bermuda, Br. S. S.	Bermuda	New York	35 09 N.	67 42 W.	2	6a, 2	2	29.93	N	NW, 5	N	N, 8	NW-N.
Pres. Roosevelt, Am. S. S.	Hamburg	do	50 06 N.	18 54 W.	2	11a, 2	3	29.38	WSW	W, 8	NNW	WSW, 9	WSW-W.
Circe Shell, Br. M. S.	Cardiff	Curacao	48 20 N.	11 00 W.	2	Mdt., 2	4	29.33	SW	SW, 8	W	SW, 8	
Yselhaven, Du. S. S.	New Orleans	Rotterdam	47 29 N.	24 06 W.	2	11a, 3	3	29.59	WNW	WNW, 9	NNW	NNW, 9	WNW-NNW.
Themisto, Du. S. S.	Swansea	Montreal	50 28 N.	36 38 W.	5	10a, 5	5	29.68	WNW	NW, 10	NW	NW, 10	WNW-NW.
Samaria, Br. S. S.	Galway	Boston	52 00 N.	33 13 W.	5	Noon, 5	6	28.94	W	W, 8	NNW	NW, 8	W-WSW.
Jean Jadot, Belg. S. S.	New York	Antwerp	48 13 N.	28 23 W.	5	Mdt., 5	6	29.24	W	NW, 9	NNW	W, 10	W-NW.
McKeesport, Am. S. S.	Havre	New York	49 10 N.	26 20 W.	6	6a, 6	7	29.22	N	N, 6	N	N, 9	None.
Boston City, Br. S. S.	Swansea	Montreal	51 39 N.	14 52 W.	7	5p, 6	7	29.09	N	SE, 5	NW	NNW, 9	S-E.
Duivendrecht, Du. M. S.	Philadelphia	Havre	38 59 N.	67 09 W.	10	4a, 10	10	29.73	SE	SE, 7	SSE	SE, 8	SE-ESE-SE.
Langleeford, Br. S. S.	Cayo Frances, Cuba.	Liverpool	38 09 N.	65 30 W.	11	3a, 11	11	29.83	S	S, 6	SSW	S, 10	S-SSW.
Steel Mariner, Am. S. S.	New York	Cristobal	16 20 N.	74 00 W.	11	6p, 11	11	29.88	ESE	ESE, 6	E	SE, 7	SE-ESE-SE
Black Condor, Am. S. S.	do	Rotterdam	48 02 N.	24 08 W.	13	6p, 12	13	29.73	NW	WNW, 6	NW	NW, 9	WNW-NW.
Floridian, Am. S. S.	Savannah	Liverpool	43 00 N.	41 10 W.	17	Mdt., 16	19	29.09	WSW	SW, 7	WSW	WSW, 9	SW-WNW.
Black Tern, Am. S. S.	Antwerp	New York	45 44 N.	40 03 W.	17	6p, 17	18	29.26	SSW	W, 9	W	W, 9	SSW-W.
Do	do	do	44 44 N.	44 12 W.	18	6p, 18	18	29.20	SSE	W, 9	N	W, 9	SSE-W-N.
Matheran, Br. S. S.	Boston	London	45 48 N.	35 06 W.	18	4a, 19	19	28.99	SW	SW, 9	W	SW, 9	SW-W.
Langleeford, Br. S. S.	Cayo Frances, Cuba.	Liverpool	49 51 N.	24 33 W.	19	Noon, 19	19	29.17	SSW	SSE, 8	SW	SSE, 9	SSW-SSE-SW.
Jean Jadot, Belg. S. S.	Antwerp	New York	49 45 N.	25 39 W.	19	Noon, 19	21	29.08	SSW	S, 9	NW	SW, 9	SSE-S-SW.
Eskdene, Br. S. S.	Philadelphia	Ardrossan	44 30 N.	40 20 W.	21	4a, 21	21	29.61	NW	NW, 8	WNW	NW, 8	N-NW.
NORTH PACIFIC OCEAN													
Silverguava, Br. M. S.	Singapore	San Francisco	45 54 N.	148 45 W.	3	2a, 4	4	29.65	NNE	N, 7	N	N, 9	N-E.
Athelchief, Br. M. S.	Nagasaki	Honolulu	32 40 N.	142 21 E.	4	6p, 4	4	29.67	SSE	S, 7	SSE	SSE, 8	SSE-S-SW.
San Pedro Maru, Jap. M. S.	San Francisco	Yokohama	36 21 N.	143 30 E.	4	Mdt., 4	4	29.70	SSE	S, 6	S	SE, 9	SE-S-SSW.
San Luis Maru, Jap. M. S.	Yokohama	San Francisco	37 41 N.	145 19 E.	5	4a, 5	5	29.65	SSE	SSE, 8	SSE	SSE, 8	None.
Shintoku Maru, Jap. M. S.	Kobe	Marshfield, Oreg.	44 30 N.	151 25 W.	14	5a, 14	14	29.29	SE	S, 7	SE	SE, 8	SE-WSW.
San Pedro, Am. S. S.	Yokohama	Los Angeles	46 25 N.	166 20 W.	14	4a, 15	15	29.53	WNW	WSW, 8	WSW	WNW, 9	WNW-WSW.
Pres. McKinley, Am. S. S.	Victoria, B. C.	Yokohama	40 25 N.	147 39 E.	18	2p, 18	18	29.53	S	SW, 7	S	S, 8	S-SW.
San Pedro, Am. S. S.	Yokohama	Los Angeles	33 44 N.	144 48 W.	19	10a, 19	19	29.73	SSW	SSW, 8	WNW	SW, 9	SSW-SW.
Peter Maersk, Dan. M. S.	do	do	46 28 N.	166 30 W.	25	6a, 25	26	29.15	SSW	SSW, 7	W	WSW, 10	SE-SW-WSW.
Pres. Grant, Am. S. S.	Seattle	Yokohama	52 03 N.	158. 10 W.	26	4a, 26	26	29.15	NE	NE, 5	N	N, 9	ESE-NE-N.

NORTH PACIFIC OCEAN, JUNE 1935

By WILLIS E. HURD

Atmospheric pressure.—Pressures close to the normal occurred throughout the North Pacific Ocean and its boundaries during June 1935. The greatest departure from the normal for the month was —0.08, at Juneau. The Aleutian LOW consisted of a shallow atmospheric trough extending from Kodiak along the Aleutian Islands to the already well developed continental LOW along the Asiatic coast. The North Pacific anticyclone extended on the average from the Washington coast southwestward and thence westward along middle latitudes well into east longitudes. The highest and lowest average pressures at island and coast stations for the month were 30.08, at Midway Island, and 29.70, at Hong Kong. The lowest pressure reading reported from a ship at sea was 29.06 inches, read on the British S. S. *Ahamo* on the 26th, near 47° N., 167° W.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, June 1935, at selected stations*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	30.03	+0.04	30.36	7	29.66	27
Dutch Harbor	29.85	−.05	30.50	3	29.32	14
St. Paul	29.90	+.04	30.38	3	29.36	22
Kodiak	29.89	−.02	30.40	5	29.56	25
Juneau	29.93	−.08	30.40	5	29.54	28
Tatoosh Island	30.05	+.03	30.41	2	29.67	6
San Francisco	29.92	−.04	30.07	9	29.74	30
Mazatlan	29.86	+.03	29.94	6, 25	29.76	11
Honolulu	30.03	−.01	30.14	15	29.90	18
Midway Island	30.08	+.03	30.18	3, 4	29.92	8
Guam	29.83	−.04	29.88	12	29.76	6, 29
Manila	29.79	+.04	29.86	5	29.72	28
Hong Kong	29.70	----------	29.80	9	29.50	15
Naha	29.79	+.04	29.90	4	29.62	2
Chichishima	29.92	+.01	30.08	26	29.70	11
Nemuro	29.79	----------	30.10	26	29.44	17

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departures are computed from best available normals related to time of observation.

Cyclones and gales.—Numerous cyclones of mostly moderate depth entered the Aleutian region, some from Asia, some from the western oceanic area, and one from the middle eastern Pacific. These depressions combined to form the Aleutian cyclone, which persisted over a fluctuating region in higher latitudes during the greater part of the month after the 6th.

No cyclone of especial consequence occurred, and reports of gales were correspondingly few. East of Japan, depressions which caused winds of gale force were somewhat active on the 4th, 5th, and 18th, with the highest force, 9, from the southeast, on the 4th, near 36° N., 143° E.

From the 3d to 6th a depression lay in middle latitudes to the north-northeast of the Hawaiian Islands. While it caused scattered velocities of force 7 during the period the highest wind accompanying its slow northward movement was a north gale of force 9 near 46° N., 149° W., on the 3d.

During the 19th to 21st scattered winds of force 7 were experienced south of the western Aleutians. The highest velocity experienced in this locality was of force 8, on the 19th.

To the southward of the eastern Aleutians and the Gulf of Alaska some storminess was met with on the 26th–28th, during the passage of the deepest LOW of the month. A considerable area to the northward of the 45th parallel, 150° to 170° W., was affected by the disturbance on the 26th, with the severest gale of the month, force 10, reported by the Danish motorship *Peter Maersk*, near 46° N., 166° W., on that date.

Fog.—Along and in the vicinity of the entire Great Circle route between San Francisco and Yokohama, fog occurred on from 2 to 7 or more well distributed days in June, with the region of greatest frequency extending from northern midocean westward and southwestward to northern Honshu. Fog formed on about 12 days off the California coast, and on 4 days off the coast of Lower California.

SEA-SURFACE TEMPERATURE SUMMARY FOR THE SOUTHWESTERN GULF OF MEXICO

By GILES SLOCUM

The monthly mean sea-surface temperatures for a representative area in the southwestern Gulf of Mexico are given in the accompanying table. The period covered is from January 1912 to December 1933, inclusive. There are 17 months, as noted in the table, for which no observational data are available. There were few observations during the years 1914 to 1919, inclusive, insufficient for any but the roughest averages to be computed. The temperatures for this period are therefore given to whole degrees. The mean temperatures for the later years, beginning with 1920, are given to tenths of a degree.

The area in which these temperature observations were taken embraces sixteen 1° squares, namely, from 90° W. to 94° W., and from 21° N. to 25° N.

Monthly and annual sea-surface temperatures in the southwestern Gulf of Mexico, 1912 to 1933, inclusive

Year [1]	Total number of observations for the year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1912	192	74.8	72.4	74.5	77.0	80.2	80.7	82.7	82.7	84.1	81.3	78.4	74.9	78.6
1913	227	73.8	74.9	73.8	75.3	76.4	78.3	81.1	82.4	82.6	80.5	78.0	74.4	77.6
1914	94	73	74	73	75	78	80	84	86	86	82	80	76	78.9
1915	44	74	74	73	75	79	82	86	85	84	79	(2)	76	78.7
1916	26	77	75	70	80	78	82	84	84	(2)	80	79	76	[3]79.1
1917	34	76	76	71	77	76	79	80	(2)	(2)	80	(2)	75	[3]77.7
1918	5	74	(2)	(2)	(2)	(2)	(2)	(2)	80	(2)	(2)	74	(2)	[3]75.6
1919	38	(2)	70	77	77	(2)	80	83	84	82	81	80	(2)	[3]78.6
1920	138	74.3	74.2	73.5	75.1	78.0	81.6	82.8	83.3	83.9	80.5	77.9	74.9	78.3
1921	273	73.6	73.7	74.6	75.9	77.8	81.1	83.2	82.4	82.8	80.8	79.0	78.0	78.6
1922	331	76.6	75.5	76.7	76.9	79.5	81.6	82.8	83.8	83.3	81.4	79.5	78.5	79.7
1923	237	76.1	75.1	75.2	76.6	79.0	81.6	82.7	84.6	83.8	82.1	77.2	76.7	79.2
1924	223	74.8	71.9	73.5	75.9	80.4	82.4	84.2	85.1	84.5	81.7	79.0	76.2	79.1
1925	219	75.1	75.1	76.4	77.3	78.8	80.2	82.6	83.2	83.7	82.5	80.3	75.5	79.2
1926	209	73.0	73.8	74.8	77.2	78.9	81.3	83.2	84.6	83.8	83.1	78.4	76.3	79.0
1927	211	74.9	74.4	74.7	76.8	80.1	82.2	84.2	84.6	84.2	82.1	79.2	76.1	79.5
1928	163	73.7	73.3	72.6	74.0	76.1	80.7	81.6	83.9	83.8	82.1	78.9	76.4	78.1
1929	146	73.1	72.6	74.7	76.8	78.8	80.5	80.4	82.7	82.2	81.2	78.3	75.7	78.1
1930	187	74.1	71.7	73.5	74.7	78.6	81.0	82.4	84.1	82.6	81.7	78.4	76.1	78.2
1931	150	75.2	72.5	71.3	72.3	76.5	81.8	83.2	83.5	83.1	82.3	79.2	78.2	78.3
1932	116	77.1	76.5	73.6	77.0	78.8	80.7	81.6	82.5	83.2	81.2	76.5	74.2	78.6
1933	193	76.6	76.3	75.2	77.1	78.9	79.8	81.6	82.4	81.6	80.2	79.8	76.2	78.8
Number of years' record		21	21	21	21	20	21	21	21	19	21	21	20	22
Mean (1912–33) [2]		74.8	73.9	73.9	76.2	78.4	80.9	82.7	83.5	83.4	81.3	78.5	76.1	[4]78.5

[1] Values for 1914 to 1919, inclusive, are given to whole degrees, instead of to tenths because of paucity of data.
[2] Computed with monthly values figured to 1 decimal place, and, therefore, not exact means of the figures given here.
[3] No data.
[4] Interpolated values are used for missing months.

CLIMATOLOGICAL TABLES

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average percipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, June 1935

[For description of tables and charts, see REVIEW, January, p. 37]

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	77.1	−1.1	4 stations	100	[1] 12	2 stations	48	[1] 6	3.70	−0.62	Riverton	7.91	Geneva	0.56
Arizona	77.4	−.7	2 stations	115	[1] 4	4 stations	31	[1] 1	.08	−.22	Payson	.75	58 stations	.00
Arkansas	74.3	−2.8	Dumas	98	26	Dutton	36	5	8.38	+4.29	Dutton	18.85	Portland	2.67
California	69.1	+.9	Greenland Ranch	119	21	Twin Lakes	21	15	.01	−.31	Crescent City (near)	.63	246 stations	.00
Colorado	62.6	+1.1	Las Animas	105	15	Telluride	16	1	.82	−.58	Burlington	5.87	7 stations	.00
Florida	80.2	+.4	2 stations	100	[1] 13	Vernon	57	25	5.17	−1.50	Titusville	16.34	Vernon	1.06
Georgia	78.3	+.2	3 stations	103	[1] 13	2 stations	44	[1] 5	2.72	−1.68	Lumber City	6.55	Tifton	.13
Idaho	60.5	+.2	2 stations	100	22	Warren	21	4	.50	−.71	Nezperce	2.51	6 stations	.00
Illinois	68.2	−3.4	7 stations	93	[1] 15	Freeport	36	7	5.99	+1.90	Carbondale	15.95	Pana	2.52
Indiana	68.2	−3.3	Shoals	99	29	Salamonia	38	8	4.75	+.92	Hobart	8.04	Rochester	2.17
Iowa	65.9	−3.7	Rockwell City	94	14	Mason City	33	7	7.00	+2.35	Indianola	13.52	Cushing (near)	2.03
Kansas	71.0	−2.7	2 stations	104	9	Oberlin	38	7	5.08	+1.08	Parsons	17.08	Deerfield	1.15
Kentucky	70.5	−3.3	Maysville	96	30	2 stations	44	[1] 9	7.50	+3.31	Greenville	17.61	Middlesboro	3.19
Louisiana	79.6	−.4	Grand Cane	99	26	Tallulah	54	5	4.70	+.05	Reserve	9.29	Jonesville	1.05
Maryland-Delaware	70.5	−.3	Cumberland, Md.	97	18	Oakland, Md.	34	1	4.56	+.61	Elkton, Md.	8.76	Keedysville, Md.	2.76
Michigan	60.9	−2.7	Croton	91	30	Roscommon No. 2	29	[1] 6	4.03	+.91	Trowbridge	7.32	Fife Lake	1.65
Minnesota	61.0	−3.9	2 stations	93	[1] 12	4 stations	28	[1] 6	4.76	+.70	Mankato	8.61	Hollock	2.25
Mississippi	77.3	−1.5	3 stations	99	[1] 26	Duck Hill	51	6	4.10	−.07	Tupelo	7.79	Macon	1.42
Missouri	69.6	−3.9	Greenville	98	29	2 stations	39	7	9.25	+4.41	Clinton	18.63	Bowling Green	2.77
Montana	58.8	−.9	Glendive	102	29	Summit	21	6	1.49	−1.01	Sahara	5.23	Browning	.38
Nebraska	66.4	−2.6	Haigler	100	9	2 stations	30	[1] 7	3.73	−.03	Hebron	8.20	Harrison	1.08
Nevada	68.6	+4.2	Logandale	112	21	Sheldon	25	14	.02	−.47	Lamoille	.40	27 stations	.00
New England	64.0	.0	2 stations	93	30	Somerset, Vt.	32	2	5.55	+2.15	Nashua, N. H.	8.66	Eastport, Maine	2.12
New Jersey	68.9	+.1	Elizabeth	96	15	2 stations	38	[1] 2	4.64	+.93	Atlantic City	7.57	Somerville	2.72
New Mexico	68.9	.0	2 stations	109	[1] 20	Horse Springs	23	1	.84	−.40	Crossroads	5.47	8 stations	.00
New York	64.5	−.4	Dansville	94	16	Indian Lake	30	2	4.45	+.80	Big Moose	7.20	Cortland	2.46
North Carolina	74.3	+.4	3 stations	101	[1] 27	Banners Elk	35	10	2.29	−2.40	Highlands	6.66	Charlotte	.50
North Dakota	60.3	−2.2	Bottineau	99	29	Maddock	25	6	3.01	−.44	Hannah	7.08	Manfred	.98
Ohio	67.4	−2.1	Hamilton	96	29	2 stations	36	[1] 1	3.96	+.18	Ironton	9.08	Willoughby	.67
Oklahoma	74.9	−2.2	Hollis	106	20	Beaver	39	7	6.67	+2.83	Webbers Falls	15.40	Kenton	.55
Oregon	60.8	+1.3	2 stations	103	5	2 stations	27	15	.78	−.43	Headworks	5.23	Danner	.00
Pennsylvania	67.4	−.5	Carlisle	96	28	3 stations	33	[1] 1	4.22	+.04	Phila. Navy Yard	7.27	Lebanon	2.19
South Carolina	77.9	+.5	Garnett	103	21	Long Creek	45	20	2.25	−2.52	Yemassee	6.79	Saluda	.52
South Dakota	63.8	−2.7	Cedar View	100	[1] 15	La Delle	28	6	2.97	−.56	Harveys Ranch	6.18	Kennebec	.89
Tennessee	72.4	−2.2	Etowah	99	27	Rugby	40	10	4.74	+.49	Tiptonville	9.15	Greenville	2.21
Texas	78.8	−1.4	Pecos	111	19	2 stations	45	7	5.07	+1.87	Rocksprings	14.10	El Paso	.09
Utah	66.4	+1.8	St. George	105	21	Soldier Summit	26	3	.05	−.51	Mountain Dell Dam	.37	37 stations	.00
Virginia	71.0	−.6	Clarksville	99	18	Burkes Garden	36	10	3.48	−.66	Lynchburg	8.53	Langley Field	1.41
Washington	60.3	−.2	2 stations	100	[1] 4	Paradise Inn	22	14	1.53	−.08	Mt. Baker Lodge	8.00	Trinidad (near)	.02
West Virginia	68.4	−1.2	Hinton	98	18	Bayard	32	1	5.20	+.83	Alpena	9.27	Upper Tract	2.29
Wisconsin	60.9	−4.2	Hancock	92	28	Rest Lake	29	6	5.12	+1.07	Marshfield	8.43	Ashland	2.43
Wyoming	58.1	−.5	Leo (near)	99	14	Buffalo Ranch	20	3	1.02	−.58	Rockypoint	3.34	2 stations	.00
Alaska (May)	39.0	−1.9	Nulato	79	30	Allakaket	−16	2	1.73	+.06	Perseverance Camp.	12.34	Barrow	T
Hawaii	74.1	+1.0	Mahukona	93	10	Kanalohuluhulu	46	[1] 3	4.82	.00	Puu Kukui (upper)	23.00	3 stations	.00
Puerto Rico	77.4	−.5	Juana Diaz No. 2	95	20	Guineo Reservoir	48	27	5.20	−1.04	La Mina	21.10	Coamo Dam	.07

[1] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, June 1935*

[Compiled by Annie E. Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	°F.		°F.	° F.		°F.	° F.	° F.	° F.	%	In.	In.		Miles								0–10	In.	In.
New England							63.5	0.0										79	5.18	+2.2										6.5		
Eastport	76	67	85	29.88	29.96	+0.03	54.8	−0.3	77	16	63	41	4	47	27	52	51	88	2.12	−0.8	11	5,826	sw.	29	e.	10	2	11	17	7.4	0.0	0.0
Greenville, Maine	1,070	6	40	29.79	29.94	.....	59.8	.....	81	3	69	40	18	50	39	.....	.....	.....	6.87	+3.9	18	2,958	se.	18	.....	14	3	10	17	.....	.0	.0
Portland, Maine	103	82	117	29.82	29.94	−.01	63.4	+.9	88	30	71	49	1	56	25	57	53	75	6.35	+3.1	15	5,836	s.	26	s.	27	12	10	8	5.3	.0	.0
Concord	289	60	.....	.....	.....	.....	64.5	+1.6	88	29	75	45	2	54	37	.....	.....	.....	7.53	+4.3	16	.....	ne.	.....	.....	.....	8	11	11	.....	.0	.0
Burlington	403	11	48	29.47	29.90	−.06	64.1	−1.6	82	30	72	45	2	56	34	.....	.....	.....	6.58	+3.2	18	6,026	s.	27	s.	3	5	7	18	7.0	.0	.0
Northfield	876	12	60	29.00	29.93	−.03	62.0	+.7	83	29	73	39	2	51	40	58	54	76	4.31	+1.1	17	4,878	s.	22	sw.	27	3	12	15	7.1	.0	.0
Boston	124	336	360	29.81	29.94	−.02	65.5	−1.0	89	29	73	50	18	58	29	59	55	72	5.07	+2.2	13	9,026	w.	43	nw.	15	4	14	12	6.6	.0	.0
Nantucket	12	14	90	29.93	29.94	−.04	61.4	+.4	75	14	67	49	8	55	19	58	57	89	6.09	+3.4	11	9,293	sw.	44	ne.	18	11	7	12	5.7	.0	.0
Block Island	26	11	46	29.92	29.95	−.02	62.2	+.4	78	26	68	50	2	56	19	59	58	90	4.39	+1.8	11	9,032	sw.	31	ne.	18	5	11	14	6.8	.0	.0
Providence	160	215	251	29.78	29.94	−.03	66.2	−2.1	89	30	75	51	10	58	28	60	55	70	4.53	+1.8	11	6,963	s.	35	nw.	15	13	7	10	5.6	.0	.0
Hartford	159	70	104	29.76	29.93	−.04	67.3	+.2	89	30	77	48	2	58	34	.....	.....	.....	2.74	−.3	15	5,514	s.	.....	.....	.....	4	12	14	6.5	.0	.0
New Haven	106	74	153	29.84	29.95	−.02	66.9	+.3	87	15	75	53	2	59	26	61	57	74	5.58	+2.5	15	5,825	s.	27	ne.	1	2	14	14	6.8	.0	.0
Middle Atlantic States							70.7	+0.2										76	4.38	+0.7									5.8		
Albany	972	97	112	29.82	29.92	−.05	68.2	+.2	87	30	77	52	2	59	30	61	57	71	5.20	+1.8	15	5,192	s.	23	ne.	17	5	13	12	6.2	.0	.0
Binghamton	871	60	68	29.02	29.94	−.03	65.4	−.2	88	17	76	45	2	55	35	.....	.....	.....	3.71	+.3	14	3,704	nw.	20	sw	17	2	14	14	7.2	.0	.0
New York	314	415	454	29.61	29.94	−.04	68.6	−.2	87	13	77	54	10	60	24	61	57	73	3.64	+.3	11	8,481	s.	39	nw.	17	5	14	11	6.2	.0	.0
Harrisburg	374	94	104	29.54	29.93	−.06	70.1	−.2	91	28	80	54	11	60	30	62	58	68	3.33	−.3	14	4,897	w.	25	nw.	27	8	13	9	5.4	.0	.0
Philadelphia	114	168	367	29.84	29.95	−.03	71.5	+.1	90	27	80	55	19	63	25	64	59	71	6.25	+3.0	15	8,308	s.	39	sw.	17	8	13	9	5.7	.0	.0
Reading	323	283	306	29.59	29.93	.....	69.9	+.1	91	27	79	53	2	61	26	62	57	67	2.76	−.8	16	7,401	nw.	47	se.	19	3	17	10	6.2	.0	.0
Scranton	805	72	104	29.09	29.94	−.04	67.6	−.2	89	17	78	49	2	57	33	59	54	65	4.33	+.7	16	4,138	sw.	24	nw.	22	7	12	11	5.7	.0	.0
Atlantic City	52	37	172	29.90	29.95	−.03	68.0	+1.4	89	15	75	52	2	61	24	63	61	82	7.57	+4.5	12	9,573	s.	34	e.	19	6	11	13	6.8	.0	.0
Sandy Hook	22	10	57	29.92	29.94	.....	68.0	.....	87	17	75	55	19	61	25	62	60	81	2.85	−.9	13	8,138	s.	33	n.	1	11	8	11	5.3	.0	.0
Trenton	190	88	106	29.74	29.94	.....	69.8	+.3	90	17	80	52	2	60	28	62	58	72	4.09	+1.0	12	6,023	s.	21	n.	1	9	11	10	6.0	.0	.0
Baltimore	123	100	215	29.81	29.94	−.05	73.6	+.9	94	18	82	59	11	65	32	65	59	64	5.01	+1.1	13	7,239	sw.	35	sw.	21	9	15	6	5.5	.0	.0
Washington	112	62	85	29.82	29.94	−.06	73.4	+1.2	95	18	84	56	11	63	30	65	60	67	3.43	−.7	11	4,543	sw.	25	nw.	5	11	14	5	4.8	.0	.0
Cape Henry	18	8	54	29.94	29.96	.....	74.0	+1.1	97	18	81	57	11	67	27	68	65	78	2.82	−1.1	8	6,653	sw.	28	s.	5	10	14	6	5.2	.0	.0
Lynchburg	686	5	.....	29.75	29.98	−.03	73.5	−1.1	97	30	87	49	2	60	34	.....	.....	.....	8.53	+4.7	16	.....	s.	.....	.....	.....	1	27	2	.....	.0	.0
Norfolk	91	80	125	29.87	29.97	−.03	75.9	+1.5	95	18	84	58	2	68	24	67	64	71	1.81	−2.4	11	6,364	sw.	30	se.	5	4	15	11	6.2	.0	.0
Richmond	144	11	52	29.82	29.97	−.04	74.4	+.3	93	18	85	55	2	64	29	66	62	69	6.22	+2.3	14	5,229	sw.	23	nw.	28	12	14	4	4.6	.0	.0
Wytheville	2,304	49	55	.....	29.95	−.06	67.0	−1.7	88	30	78	45	10	56	32	.....	.....	72	2.85	−1.4	12	4,126	w.	22	nw.	21	13	11	6	.....	.0	.0
South Atlantic States							77.9	−1.4										69	2.33	−2.3									5.2		
Asheville	2,253	89	104	27.70	29.99	−.02	69.8	+1.1	89	21	81	47	10	58	33	61	57	70	2.36	−1.6	14	4,794	nw.	30	w.	18	8	14	8	5.3	.0	.0
Charlotte	779	63	86	29.16	29.98	−.03	77.6	+2.1	95	21	88	56	10	67	30	66	59	57	.50	−3.7	7	5,220	sw.	26	sw.	18	9	14	7	5.1	.0	.0
Greensboro	886	6	56	29.05	29.98	.....	73.9	.....	94	28	86	50	10	62	35	65	61	68	1.92	.....	11	5,249	sw.	31	w.	17	5	18	7	5.9	.0	.0
Hatteras	11	5	50	.....	29.98	−.03	76.0	+.4	88	15	82	60	3	71	18	.....	.....	86	4.08	−.4	7	7,989	sw.	32	nw.	23	12	11	7	.....	.0	.0
Raleigh	376	103	146	29.57	29.96	−.05	77.5	+1.8	96	28	88	56	10	67	28	67	62	63	.90	−3.5	5	5,821	sw.	30	w.	19	13	14	3	4.4	.0	.0
Wilmington	72	73	107	29.92	29.99	−.02	77.6	+.8	92	13	86	59	10	70	22	71	68	75	2.33	−2.8	8	6,501	sw.	27	nw.	19	15	11	4	4.2	.0	.0
Charleston	48	11	92	29.94	29.99	−.02	80.2	+1.3	93	22	86	69	10	74	20	72	69	72	3.45	−1.1	7	7,310	sw.	31	w.	19	4	14	12	6.7	.0	.0
Columbia, S. C	347	67	73	29.62	29.99	−.02	80.0	+1.1	98	21	90	63	10	70	30	67	61	59	2.06	−2.1	6	4,804	sw.	20	sw.	16	10	15	5	4.6	.0	.0
Greenville, S. C	1,039	139	.....	.....	.....	.....	76.0	+1.9	94	28	86	58	10	66	28	.....	.....	.....	2.71	−1.8	7	.....	w.	.....	.....	.....	18	8	4	.....	.0	.0
Augusta	182	62	77	29.78	29.98	−.03	79.9	+1.2	98	13	91	62	6	69	32	69	63	63	2.71	−2.0	11	4,306	nw.	24	sw.	3	7	15	8	5.5	.0	.0
Savannah	65	73	152	29.92	29.99	−.02	81.4	+2.4	98	13	91	68	6	72	25	72	69	72	1.50	−3.8	11	7,177	sw.	23	sw.	15	9	12	9	5.4	.0	.0
Jacksonville	43	86	110	29.96	30.00	−.01	81.4	+1.5	96	14	90	68	4	73	22	72	70	75	3.03	−2.3	12	5,238	s.	24	w.	4	7	18	5	5.4	.0	.0
Florida Peninsula							81.9	+1.2										74	8.21	+2.0									5.7		
Key West	22	10	64	29.96	29.98	−.01	83.8	+1.9	93	19	90	71	30	78	19	76	73	71	2.62	−1.6	7	5,136	se.	19	ne.	30	8	17	5	5.2	.0	.0
Miami	25	124	168	29.99	30.02	+.02	80.4	+1.4	88	5	86	67	9	74	20	74	72	76	6.21	−.6	18	5,116	se.	26	n.	9	2	12	16	7.2	.0	.0
Tampa	35	88	197	29.96	29.99	−.02	81.6	+1.4	95	12	90	68	12	73	27	73	71	76	7.66	+.4	15	5,969	s.	42	se.	12	10	15	5	4.8	.0	.0
Titusville	43	5	36	29.96	30.01	.....	79.0	.....	92	17	89	64	4	69	28	.....	.....	.....	16.34	+9.6	16	.....	se.	.....	.....	.....	2	18	10	.....	.0	.0
East Gulf States							78.3	−0.3										70	3.28	−1.4									5.3		
Atlanta [1]	1,173	128	135	28.98	29.97	−.04	76.3	+.3	95	12	88	55	7	65	33	67	62	67	2.33	−1.4	12	5,170	nw.	30	sw.	13	6	13	11	6.3	.0	.0
Macon	370	79	87	29.59	29.98	−.03	78.7	−.2	96	21	90	56	7	67	35	68	62	62	2.04	−2.0	11	4,554	n.	24	s.	8	9	15	6	5.0	.0	.0
Thomasville	273	49	58	29.72	30.01	+.01	79.6	+.1	95	15	91	64	6	69	30	72	68	74	1.58	−3.9	8	.....	sw.	.....	.....	.....	7	10	13	.....	.0	.0
Apalachicola	35	11	51	29.96	30.00	.....	80.0	.....	92	18	87	68	6	73	21	73	.....	.....	4.52	−1.1	8	.....	w.	.....	.....	.....	7	16	7	.....	.0	.0
Pensacola	56	149	185	29.94	30.00	+.01	78.8	−.5	90	19	85	65	28	73	22	72	68	71	2.06	−2.6	9	7,699	s.	31	ne.	28	13	13	4	4.0	.0	.0
Anniston	741	9	.....	.....	.....	.....	75.2	+.2	93	28	87	51	6	63	36	.....	.....	.....	5.18	+1.1	8	.....	nw.	.....	.....	.....	11	13	6	.....	.0	.0
Birmingham	700	11	48	29.23	29.98	−.01	75.9	−2.0	92	27	86	54	6	66	29	68	64	73	6.74	+2.3	13	4,201	s.	27	s.	1	7	15	8	5.5	.0	.0
Mobile	57	125	161	29.92	29.98	−.01	79.4	−.9	93	18	87	67	11	72	23	72	68	73	2.99	−2.4	11	5,848	s.	31	n.	30	9	11	10	5.4	.0	.0
Montgomery	218	92	105	29.75	29.99	−.01	79.6	.0	95	12	90	63	6	70	27	69	65	69	1.66	−2.1	8	4,506	n.	25	s.	14	6	14	10	6.1	.0	.0
Meridian	375	67	92	29.59	29.98	.00	77.8	−.3	95	27	88	58	5	67	30	69	65	69	1.60	−3.0	11	3,977	sw.	22	w.	3	11	14	5	4.7	.0	.0
Vicksburg	247	65	73	29.72	29.97	.00	78.0	−1.0	93	27	87	65	6	69	22	70	66	72	5.26	+1.3	9	4,911	se.	27	ne.	11	10	11	9	5.4	.0	.0
New Orleans	53	76	84	29.93	29.98	.00	81.9	+1.3	93	20	89	69	7	75	23	73	70	71	3.45	−2.4	12	4,185	se.	21	nw.	18	6	14	10	5.7	.0	.0
West Gulf States							78.8	−0.9										77	5.97	+2.5									5.4		
Shreveport	249	92	227	29.69	29.95	−.01	80.0	−.7	96	26	89	64	3	71	24	71	68	72	2.95	−.6	9	6,964	s.	34	ne.	3	9	16	5	4.8	.0	.0
Bentonville	1,303	11	44	28.57	29.91	−.03	70.4	−3.7	89	11	80	47	5	61	31	.....	.....	.....	9.76	+4.4	19	4,397	s.	30	nw.	17	6	11	13	.....	.0	.0
Fort Smith	457	79	94	29.44	29.92	−.02	75.0	−2.5	93	11	84	54	5	66	30	67	64	74	10.42	+6.7	14	5,294	e.	30	sw.	17	6	14	10	6.0	.0	.0
Little Rock	357	94	102	29.58	29.95	−.01	75.5	−1.9	91	11	84	60	5	67	25	68	65	73	5.51	+1.8	16	5,287	s.	29	n.	3	7	11	13	6.0	.0	.0
Austin	605	136	148	29.28	29.91	.....	80.0	−1.2	93	19	88	66	1	72	22	73	70	77	9.71	+7.3	12	5,865	se.	26	s.	2	5	14	11	6.0	.0	.0
Brownsville	57	88	96	29.81	29.87	.....	82.1	−.3	91	3	88	70	10	76	19	76	74	84	4.97	+2.1	10	8,237	se.	40	se.	4	6	18	6	5.5	.0	.0
Corpus Christi	20	11	78	29.87	29.89	−.02	81.8	+.8	90	20	87	70	5	77	15	76	75	81	1.56	−1.0	11	8,606	se.	35	se.	3	9	12	9	5.5	.0	.0
Dallas	512	220	227	29.36	29.90	.....	77.6	.....	93	27	85	61	8	70	26	70	67	73	7.17	+3.3	9	7,966	se.	38	sw.	17	10	8	12	5.9	.0	.0
Fort Worth	679	92	110	29.21	29.91	−.01	78.6	−1.3	93	27	88	61	5	70	26	.....	.....	.....	7.22	+3.9	10	7,255	s.	32	w.	17	16	10	4	3.3	.0	.0
Galveston	54	106	114	29.88	29.94	−.01	81.9	+1.2	89	23	86	67	3	78	14	76	73	79	3.89	−.5	7	7,937	s.	27	s.	16	12	12	6	4.8	.0	.0
Houston	138	292	314	29.80	29.94	.....	81.0	−.4	95	19	89	67	4	74	22	.....	.....	.....	3.59	−1.0	13	7,711	s.	27	se.	15	8	17	5	5.2	.0	.0
Palestine	510	64	72	29.41	29.93	−.01	79.3	+.3	93	27	88	64	6	70	27	72	69	75	2.42	−1.2	7	5,588	s.	24	n.	27	5	17	8	5.6	.0	.0
Port Arthur	34	58	66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Antonio	693	242	301	29.18	29.88	−.02	79.5	−1.5	92	9	87	66	2	72	22	73	71	80	8.41	+6.0	11	8,156	se.	41	se.	2	3	18	9	6.3	.0	.0

TABLE 1.—*Climatological data for Weather Bureau stations, June 1935*—Continued

[Compiled by Annie E. Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	° F.	° F.	°F.		°F.	° F.		°F.	° F.	° F.	° F.	%	In.	In.		Miles								0–10	In.	In.
Ohio Valley and Tennessee							70.8	−2.0										72	4.24	+0.3										6.3		
Chattanooga	762	71	214	29.19	29.98	−0.02	75.4	0.0	94	13	86	52	6	65	29	67	63	69	3.50	−0.7	11	5,062	w.	31	w.	21	9	11	10	5.4	0.0	0.0
Knoxville	995	66	84	28.95	29.98	−.02	73.6	−.4	92	29	84	54	6	63	29	65	60	67	4.14	.0	14	3,826	sw.	25	w.	19	12	11	7	4.6	.0	.0
Memphis	399	78	86	29.54	29.95	−.02	75.2	−2.4	91	28	83	60	9	68	21	68	64	70	6.16	+2.6	12	4,708	sw.	32	sw.	13	10	8	12	5.5	.0	.0
Nashville	546	168	191	29.40	29.98	−.01	72.9	−2.7	93	28	82	52	6	64	29	65	61	71	2.81	−1.2	15	5,787	sw.	30	sw.	18	3	18	9	6.6	.0	.0
Lexington	989	6																														
Louisville	525	188	234	29.39	29.97	−.01	70.3	−4.4	91	30	78	52	9	63	27	64	60	72	4.96	+1.1	12	6,798	sw.	30	sw.	17	6	9	15	6.6	.0	.0
Evansville	431	76	116	29.48	29.94	−.03	71.6	−3.5	91	30	80	54	9	63	24	64	61	72	4.96	+.9	14	6,129	sw.	33	s.	21	4	11	15	6.8	.0	.0
Indianapolis	822	194	230	29.06	29.94	−.03	68.6	−3.0	93	29	77	48	8	60	25	61	57	70	4.66	+1.0	16	6,727	sw.	29	w.	19	0	18	12	6.9	.0	.0
Terre Haute	575	96	129	29.30	29.91		70.2		93	30	80	49	8	60	27	63	59	71	4.45	+.5	14	6,085	sw.	26	w.	26	7	9	14	6.5	.0	.0
Cincinnati	627	11	51	29.28	29.95	−.04	69.2	−2.0	90	29	79	47	9	60	30	62	59	75	3.98	+.3	16	4,751	sw.	24	sw.	19	7	7	16	6.7	.0	.0
Columbus	822	90	210	29.08	29.94	−.05	69.2	−1.7	92	29	79	46	8	60	30	62	57	68	2.40	−.9	13	6,606	s.	41	sw.	18	8	10	12	6.3	.0	.0
Dayton	900	58	153	28.98	29.92		69.0	−2.4	92	29	78	46	8	60	28				3.80	.0	12	5,930	sw.	27	sw.	19	5	13	12	6.4	.0	.0
Elkins	1,947	59	78	27.99	29.99	−.01	65.2	−1.7	88	18	76	42	1	54	36	60	57	82	6.19	+1.1	16	3,841	w.	28	sw.	21	2	14	14	6.9	.0	.0
Parkersburg	637	77	84	29.34	29.99	−.01	69.8	−1.6	90	18	80	47	10	60	29	63	60	75	4.06	+.1	16	4,196	se.	20	nw.	2	5	10	15	6.9	.0	.0
Pittsburgh	842	164	410	29.06	29.95	−.04	70.1	−.6	90	29	80	52	10	60	33	63	59	73	3.35	−.5	13	6,501	sw.	34	w.	18	6	9	15	6.7	.0	.0
Lower Lake Region							65.3	−1.4										70	3.18	−0.2										6.1		
Buffalo	768	243	280	29.10	29.92	−.05	63.6	−.8	86	2	70	50	9	57	31	58	54	74	3.06	+.2	15	9,323	sw.	40	sw.	20	9	10	11	5.6	.0	.0
Canton	448	10	61	29.42	29.89		63.8	−2.0	82	2	74	42	1	54	35				4.40	+1.1	14	5,794	sw.	25	sw.	7	8	9	13	6.1	.0	.0
Ithaca	836	77	100	29.04	29.93		64.8	−1.4	88	28	77	44	1	53	38	59	55	71	3.39	−.2	14	5,874	nw.	28	s.	19	2	13	15	7.0	.0	.0
Oswego	335	71	85	29.56	29.92	−.05	63.6	−1.2	85	28	72	46	2	55	36	57	53	72	2.95	−.3	13	5,952	s.	30	se.	19	6	13	11	6.3	.0	.0
Rochester	523	86	102	29.36	29.93	−.04	65.8	−.3	87	14	75	47	8	56	34	58	53	65	3.31	+.3	12	5,481	sw.	24	w.	20	11	11	8	5.3	.0	.0
Syracuse	596	65	79	29.30	29.94	−.03	66.2	−.7	88	14	76	47	10	56	34				4.38	+.5	12	4,849	s.	21	nw.	7	6	10	14	6.5	.0	.0
Erie	714	130	166	29.17	29.93	−.05	65.4	−.8	89	14	74	48	8	57	29	59	55	69	2.68	−.7	14	8,061	w.	30	sw.	14	10	12	8	5.0	.0	.0
Cleveland	762	267	337	29.11	29.93	−.05	66.0	−1.1	85	26	73	49	8	59	25	59	55	68	1.45	−1.7	10	8,434	s.	40	w.	4	5	15	10	6.0	.0	.0
Sandusky	629	5	67	29.25	29.92	−.06	66.4	−2.4	88	26	76	43	8	57	31				2.71	−.8	17	5,910	sw.	22	sw.	14	4	11	15	6.8	.0	.0
Toledo	628	79	87	29.26	29.93	−.04	66.4	−2.3	86	28	75	48	8	58	25	59	54	67	2.79	−.5	14	6,365	w.	32	w.	4	11	10	9	5.4	.0	.0
Fort Wayne	857	69	84	29.01	29.92		67.0	−1.5	90	30	76	47	8	58	28	60	55	70	3.00	−.6	15	6,088	sw.	24	sw.	19	5	12	13	6.4	.0	.0
Detroit [1]	626	5	78	29.24	29.92	−.05	64.6	−2.8	85	14	74	43	8	56	27	59	54	71	4.00	+.4	14	6,492	sw.	33	w.	4	6	10	14	6.7	.0	.0
Upper Lake Region							60.2	−2.2										74	4.21	+0.9										6.8		
Alpena	609	13	89	29.23	29.90	−.06	60.0	−.4	86	14	69	41	6	51	32	54	51	76	4.66	+1.4	16	7,129	se.	27	nw.	16	8	10	12	6.2	.0	.0
Escanaba	612	54	60	29.22	29.87	−.07	58.2	−2.5	82	27	66	40	6	50	26	53	49	77	4.04	+.8	17	6,714	s.	27	n.	19	4	11	15	7.0	.0	.0
Grand Rapids	707	70	244	29.13	29.89	−.08	64.8	−3.0	87	30	74	48	7	56	28	58	53	69	4.95	+1.5	13	7,304	sw.	41	sw.	14	8	8	14	6.8	.0	.0
Lansing	878	6	88	28.97	29.90		62.8	−3.6	83	16	72	42	8	54	28	59	56	79	4.95	+1.4	14	5,743	s.	21	sw.	19	5	10	15	6.8	.0	.0
Ludington	637	5	54	29.20	29.89		58.8	−1.7	84	30	66	44	1	52	31	54			1.66	−1.2	10		s.				5	12	13		.0	.0
Marquette	734	77	111	29.06	29.86	−.08	56.2	−2.7	81	27	64	37	6	49	29	51	47	73	3.29	+.1	17	6,339	nw.	29	s.	25	4	12	14	6.9	.0	.0
Sault Ste. Marie	614	11	52	29.20	29.89	−.07	56.4	−2.2	82	30	66	38	6	46	34	51	47	74	5.15	+2.2	16	4,746	w.	19	nw.	23	5	8	17	6.8	.0	.0
Chicago	673	7	131	29.18	29.90	−.06	65.1	−2.2	84	14	73	49	6	58	29	59	55	74	5.03	+1.7	12	6,381	w.	25	sw.	14	6	10	14	6.7	.0	.0
Green Bay	617	109	141	29.20	29.86	−.09	62.0	−2.9	85	14	71	43	7	53	28	56	51	69	4.69	+1.0	14	7,808	w.	35	ne.	18	4	8	18	7.3	.0	.0
Milwaukee	681	97	221	29.16	29.88	−.07	61.6	−2.3	84	16	69	45	7	54	30	56	52	72	4.34	+.9	15	8,024	w.	34	w.	4	3	14	13	7.0	.0	.0
Duluth	1,133	5	47	28.64	29.84	−.08	56.2	−1.0	81	29	65	36	4	48	29	51	47	75	3.57	−.3	17	8,422	ne.	31	ne.	17	7	7	16	6.9	.0	.0
North Dakota							61.2	−2.0										67	2.72	−0.9										5.9		
Moorhead, Minn	940	50	58	28.83	29.83	−.07	61.9	−2.5	86	13	72	33	6	52	32	55	50	69	3.01	−1.0	10	6,566	n.	33	n.	13	5	12	13	6.5	.0	.0
Bismarck	1,674	8	57	28.07	29.83	−.04	62.2	−1.5	87	30	72	37	6	52	36	55	49	67	2.82	−.5	11	7,237	nw.	34	s.	1	7	16	7	5.7	.0	.0
Devils Lake	1,478	11	44	28.27	29.83	−.05	59.7	−2.2	85	30	71	30	5	49	34	53	43	69	1.97	−1.6	10	6,846	se.	29	nw.	3	6	13	11	6.2	T	.0
Grand Forks	833	12	67				61.2		84	30	72	31	6	50	35	55			2.46		14		se.	36	se.	13	4	19	7		T	.0
Williston	1,878	41	48	27.88	29.83	−.03	60.8	−1.9	91	29	71	38	6	51	37	53	47	64	3.08	−.4	7	6,721	nw.	30	nw.	3	9	12	9	5.2	.0	.0
Upper Mississippi Valley							67.2	−3.3										72	5.83	+1.7										6.5		
Minneapolis	918	102	208	28.89	29.86		64.3	−3.2	89	13	73	41	4	56	25	56	51	64	4.82	+.6	15	8,117	w.	31	s.	24	3	14	13	5.6	.0	.0
La Crosse	714	11	48	29.10	29.86	−.07	64.4	−3.9	88	14	74	39	7	55	30	58	54	72	5.03	+1.0	17	3,906	s.	15	nw.	4	8	9	13	6.5	.0	.0
Madison	974	70	78	28.84	29.87	−.07	63.4	−3.8	84	13	71	43	5	55	23	58	54	75	4.94	+1.2	16	5,902	sw.	26	se.	25	4	10	16	7.1	.0	.0
Charles City	1,015	10	51	28.82	29.88	−.03	64.0	−2.5	88	13	74	37	7	54	30	58	54	72	6.91	+2.3	14	5,045	w.	22	n.	9	8	12	10	5.7	.0	.0
Davenport	606	66	161	29.24	29.89	−.05	67.6	−2.9	89	13	76	46	7	59	25	61	57	71	5.12	+1.0	12	6,643	sw.	27	nw.	4	6	8	16	7.0	.0	.0
Des Moines	861	5	99	28.99	29.88	−.04	67.2	−3.4	86	14	76	44	7	58	26	61	57	72	7.75	+3.0	13	6,789	s.	29	nw.	3	5	15	10	6.3	.0	.0
Dubuque	700	60	79	29.14	29.88	−.05	65.6	−3.8	87	13	74	42	7	57	26	59	55	70	4.75	+.4	16	4,373	nw.	19	se.	10	6	6	18	7.0	.0	.0
Keokuk	614	64	78	29.24	29.91	−.03	69.0	−3.5	88	30	78	47	7	60	27	62	59	73	6.40	+2.3	12	5,289	sw.	28	nw.	19	2	11	17	7.2	.0	.0
Cairo	358	87	93	29.56	29.94	−.03	72.6	−3.7	89	30	80	56	8	65	20	66	64	78	7.51	+3.7	17	5,540	sw.	27	sw.	12	4	8	18	7.1	.0	.0
Peoria	609	11	45	29.26	29.92	−.03	67.4	−3.5	89	15	77	48	8	58	29	62	59	77	6.62	+2.8	15	4,379	s.	18	w.	4	11	8	11	5.7	.0	.0
Springfield, Ill	636	5	191	29.24	29.90	−.05	69.9	−2.3	89	28	79	51	7	61	28	63	59	73	5.69	+1.6	14	7,313	s.	25	nw.	19	4	11	15	6.7	.0	.0
St. Louis	568	265	303	29.32	29.91	−.04	71.8	−3.3	90	28	80	50	7	63	24	64	60	72	4.37	+.6	16	8,390	sw.	32	nw.	19	8	12	10	5.7	.0	.0
Missouri Valley							68.7	−2.5										72	5.18	+0.7										5.5		
Columbia, Mo	784	6	84	29.07	29.89	−.06	69.6	−3.2	89	30	78	50	7	61	26				5.72	+1.0	16	5,347	w.	23	w.	18	9	12	9	5.8	.0	.0
Kansas City [1]	750	32	45	29.10	29.89	−.03	71.6	−2.0	91	10	81	46	7	62	31	64	60	72	3.24	−1.8	17	6,744	sw.	36	nw.	1	4	14	12	6.6	.0	.0
St. Joseph	967	11	49	28.87	29.88		69.5		88	27	79	44	7	60	25	63	59	72	8.20	+3.3	16	5,667	se.	30	nw.	4	9	13	8	5.6	.0	.0
Springfield, Mo	1,324	98	104	28.55	29.93	−.02	69.0	−3.5	87	10	77	48	7	61	26	64	61	79	11.31	+6.6	17	6,844	se.	30	nw.	2	15	12	3	3.8	.0	.0
Iola	984	11	50	28.88	29.89	−.04	71.6	−2.5	90	10	82	46	7	62	31				7.48	+2.0	15		nw.				2	15	13		.0	.0
Topeka	987	65	87				71.2	−2.2	94	10	82	45	7	61	28				5.05	+.4	19	6,412	s.	28	nw.	18	6	18	6	5.5	.0	.0
Lincoln	1,189	11	81	28.63	29.87	−.03	68.6	−2.8	90	24	78	41	7	59	29	62	59	75	3.81	−.5	13	6,814	s.	41	n.	2	4	18	8	6.0	.0	.0
Omaha	1,105	170	200	28.84	29.88	−.03	68.2	−3.4	92	16	78	40	7	59	29	62	58	74	5.25	+.7	12	7,211	se.	34	se.	24	4	16	10	5.9	.0	.0
Valentine	2,598	47	54	27.23	29.91	+.05	64.5	−2.4	95	13	76	37	7	53	34	57	53	70	3.00	+.1	11	6,957	s.	27	nw.	5	10	14	6	4.8	.0	.0
Sioux City	1,138	64	106	28.68	29.86	−.04	67.4	−2.1	92	14	77	42	7	58	31	60	54	66	2.16	−1.8	9	7,130	nw.	32	se.	24	2	16	12	6.7	.0	.0
Huron	1,306	60	74	28.49	29.87	−.01	65.0	−1.2	91	13	76	39	7	54	32	57	52	65	1.78	−2.0	10	7,482	se.	46	w.	24	10	15	5	4.4	.0	.0
Northern Slope							61.0	−0.5										54	1.43	−0.9										5.3		
Billings	3,570	17	31																													
Havre	2,505	11	67	27.27	29.87	+.02	61.8	−.2	94	22	75	34	6	48	43	49	38	51	.67	−2.2	7	6,614	nw.	35	w.	29	8	14	8	5.3	.0	.0
Helena	4,124	85	111	25.77	29.90	+.02	59.2	.0	88	22	70	37	6	48	38	47	35	45	.39	−1.8	8	7,047	sw.	28	s.	28	3	14	13	6.9	.0	.0
Kalispell	2,973	48	56		29.91	+.02	57.5	−.2	88	22	70	34	6	45	39			58	1.03	−1.0	6	5,086	w.	27	w.	2	7	15	8		.0	.0
Miles City	2,371	48	55	27.37	29.88	+.03	64.6	−1.4	97	29	76	40	6	53	35	53	44	52	1.84	−.8	12	5,263	nw.	28	nw.	20	8	15	7	4.8	.0	.0
Rapid City	3,259	50	58	26.55	29.90	+.05	62.6	−1.6	89	29	73	36	7	52	43	54	47	57	1.93	−1.4	13	6,185	n.	32	n.	3	5	19	6	5.3	.0	.0
Cheyenne	6,094	50	71	24.00	29.85	+.01	59.8	−.6	87	15	73	37	4	47	37	50	43	60	2.75	+1.1	12	6,653	w.	29	w.	24	9	15	6	5.0	T	.0
Lander	5,372	60	68	24.62	29.85	.00	62.2	+1.7	89	22	77	36	3	48	43	48	36	45	.17	−1.0	3	4,333	sw.	31	sw.	12	8	16	6	5.1	.0	.0
Sheridan	3,790	10	47	26.04	29.88		60.6		93	29	75	36	25	46	45	51	43	57	1.72	−.3	10	4,182	nw.	26	nw.	1	8	18	4	4.9	T	.0
Yellowstone Park	6,241	11	48	23.88	29.89	+.03	54.1	−1.9	81	22	68	32	3	40	39	43	33	52	.46	−1.5	9	5,991	sw.	31	sw.	14	5	17	8	6.1	T	.0
North Platte	2,821	11	51	27.00	29.88	+.02	67.0	−.5	93	9	78	39	7	56	34	59	54	68	3.18	.0	9	5,712	se.	24	n.	20	10	15	5	4.6	.0	.0

TABLE 1.—*Climatological data for Weather Bureau stations, June 1935*—Continued

[Compiled by Annie E. Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Middle Slope							70.6	−1.3										62	3.75	+0.6										5.1		
Denver	5,292	106	113	24.70	29.85	+0.01	66.7	+0.4	93	30	79	42	6	54	34	52	42	48	0.60	−0.8	6	5,850	s.	30	nw.	2	7	20	3	5.1	0.0	0.0
Pueblo	4,685	80	86	25.24	29.83	.00	70.0	+1.0	96	30	84	46	7	56	39	53	41	45	1.03	−.3	4	5,060	e.	21	nw.	23	13	17	0	3.9	.0	.0
Concordia	1,392	50	58	28.46	29.90	.00	69.6	−3.4	93	24	79	43	7	60	30	63	59	72	7.58	+3.2	15	6,040	s.	26	s.	28	6	18	6	5.4	.0	.0
Dodge City	2,509	10	86	27.34	29.88	+.01	71.4	−1.1	100	9	83	44	7	60	36	62	56	66	1.95	−1.4	10	9,828	s.	35	ne.	2	13	11	6	4.4	.0	.0
Wichita	1,358	85	93	28.48	29.88	−.03	71.2	−3.2	93	10	80	46	7	62	26	64	60	70	7.21	+2.8	15	7,860	se.	38	nw.	26	6	11	13	6.0	.0	.0
Oklahoma City	1,214	10	47	28.64	29.88	−.03	74.4	−1.6	93	10	84	51	7	65	34	67	64	74	4.11	+.4	14	7,054	s.	23	s.	25	9	8	13	5.8	.0	.0
Southern Slope							76.9	−1.0										63	5.02	+2.5										4.8		
Abilene	1,738	10	52	28.10	29.87	−.01	77.6	−1.6	97	20	88	58	5	68	33	68	64	69	5.16	+2.2	10	7,924	s.	38	nw.	17	11	11	8	5.1	.0	.0
Amarillo	3,676	10	49	26.22	29.85	.00	74.4	+1.6	105	20	87	47	7	62	38	61	53	57	.28	−2.6	4	7,473	s.	24	se.	26	14	13	3	3.9	.0	.0
Big Spring	2,537	5	62	27.29	29.85	------	76.8	------	102	20	88	54	5	66	30	66	62	67	3.28	------	9	------	s.	------	------	------	9	16	5	------	.0	.0
Del Rio	944	64	71	28.85	29.81	−.04	79.6	−3.8	94	21	87	62	4	72	26	72	70	76	13.71	+11.2	11	7,411	se.	40	nw.	4	2	16	12	6.7	.0	.0
Roswell	3,566	75	85	26.30	29.81	+.01	75.9	−.4	103	20	89	52	5	62	36	59	47	46	.95	−.7	3	6,352	s.	27	s.	29	17	11	2	3.3	.0	.0
Southern Plateau							77.2	+3.0										31	0.26	−0.1										1.7		
El Paso	3,778	152	175	26.10	29.76	+.01	81.2	+1.6	102	19	94	62	1	68	34	58	41	30	.09	−.5	3	7,294	e.	42	ne.	22	20	10	0	2.2	.0	.0
Albuquerque	4,972	5	39	25.00	29.74	------	72.0	------	97	20	89	43	1	55	42	52	36	36	1.40	+.9	1	6,494	se.	42	nw.	28	20	9	1	2.6	.0	.0
Santa Fe	7,013	38	53	23.28	29.77	−.04	66.2	+1.4	88	20	80	44	1	53	35	48	33	34	.07	−1.0	2	4,647	e.	25	ne.	22	18	10	2	3.1	.0	.0
Flagstaff	6,907	10	59	23.37	29.79	+.01	61.5	+2.2	87	21	80	32	1	43	45	44	----	36	.13	------	2	6,552	sw.	25	sw.	23	18	12	0	----	.0	.0
Phoenix	1,108	10	107	28.59	29.70	−.04	89.2	+4.7	110	11	106	59	1	73	40	59	34	18	.00	−.1	0	4,723	w.	23	w.	23	28	1	1	.7	.0	.0
Yuma	141	9	54	29.56	29.70	−.04	87.8	+3.1	113	5	106	58	1	70	42	64	48	33	.00	.0	0	4,061	w.	21	w.	23	30	0	0	.0	.0	.0
Independence	3,957	5	26	25.88	29.82	+.04	77.2	+4.9	101	21	94	52	1	60	39	53	----	----	.00	−.1	0	------	n.	----	------	----	28	2	0	----	.0	.0
Middle Plateau							68.8	+3.6										30	0.05	−0.5										2.1		
Reno	4,521	61	76	25.44	29.85	−.01	67.1	+6.1	92	20	83	40	15	51	40	49	34	36	.01	−.3	1	5,517	w.	26	w.	13	28	1	1	1.4	.0	.0
Tonopah	6,090	12	20	------	------	------	70.4	------	92	21	84	47	15	57	33	48	27	22	.00	------	0	------	nw.	----	----	----	----	----	----	----	----	----
Winnemucca	4,344	18	56	25.58	29.90	+.02	65.7	+2.9	94	21	84	36	30	48	46	48	32	36	T	−.7	0	5,439	ne.	22	sw.	13	18	11	1	2.6	.0	.0
Modena	5,473	10	46	24.57	29.78	−.04	67.0	+3.7	94	21	86	38	1	48	45	67	26	26	T	−.3	0	7,822	sw.	31	sw.	12	27	3	0	1.3	.0	.0
Salt Lake City	4,357	86	210	25.55	29.83	−.02	69.9	+2.5	95	22	83	44	3	57	34	52	37	34	.13	−.7	1	5,458	nw.	34	nw.	27	19	9	2	2.9	.0	.0
Grand Junction	4,602	60	68	25.29	29.79	−.04	74.2	+2.8	96	14	89	46	3	59	38	51	31	26	.09	−.3	2	5,212	se.	28	se.	28	22	7	1	2.2	.0	.0
Northern Plateau							64.4	+0.8										44	0.49	−0.6										4.9		
Baker	3,471	48	53	26.44	29.99	+.04	58.8	+.2	88	21	74	36	3	44	44	48	39	53	.53	−.8	5	4,186	n.	19	n.	22	8	15	7	5.4	.0	.0
Boise	2,739	79	87	27.10	29.92	+.01	66.1	+.8	94	22	80	42	3	52	40	51	38	44	.06	−.9	1	3,939	nw.	22	nw.	12	11	12	7	4.8	.0	.0
Pocatello	4,477	60	68	25.42	29.86	−.01	64.8	+2.6	93	22	78	41	3	51	41	48	33	34	.02	−1.1	1	6,543	sw.	29	sw.	27	15	11	4	3.7	.0	.0
Spokane	1,929	101	110	27.91	29.93	−.01	62.4	−.4	87	7	75	42	3	50	38	50	39	49	.77	−.5	4	5,693	s.	24	sw.	22	6	16	8	5.6	.0	.0
Walla Walla	991	57	65	28.88	29.94	−.02	67.6	+1.1	92	21	79	47	2	56	38	53	39	40	.86	−.3	6	4,775	w.	19	w.	29	14	8	8	4.7	.0	.0
Yakima	1,076	58	67	28.82	29.95	------	66.6	+.2	96	5	79	48	2	54	39	53	42	46	.69	+.1	5	5,227	nw.	22	w.	22	11	11	8	5.1	.0	.0
North Pacific Coast Region							60.4	+2.0										67	1.03	−0.7										5.7		
North Head	211	11	56	29.84	30.07	+.08	56.0	+1.2	77	6	60	47	3	52	27	53	50	83	1.53	−.8	18	9,895	n.	40	s.	7	6	13	11	6.1	.0	.0
Seattle	125	90	321	29.90	30.03	+.03	61.6	+2.6	86	6	70	48	3	54	29	54	48	65	1.81	+.5	11	6,579	n.	30	s.	7	7	12	11	5.7	.0	.0
Tatoosh Island	86	10	54	29.96	30.05	+.03	55.3	+2.3	76	6	59	46	3	51	19	52	50	85	2.01	−1.2	20	6,711	w.	36	s.	7	4	6	20	7.4	.0	.0
Medford	1,329	29	58	28.59	29.98	------	65.6	------	102	5	82	41	1	49	50	53	42	50	T	−.7	0	5,142	nw.	23	nw.	12	13	15	2	4.1	.0	.0
Portland, Oreg	153	68	106	29.87	30.03	−.01	64.4	+2.0	96	6	74	42	2	54	37	55	48	59	.50	−1.0	9	4,740	nw.	16	nw.	1	8	7	15	6.0	.0	.0
Roseburg	510	45	76	29.66	30.04	+.01	64.6	+2.1	99	6	78	42	15	51	45	54	47	60	.34	−.8	5	3,780	n.	15	n.	21	12	6	12	4.8	.0	.0
Middle Pacific Coast Region							63.7	+3.0										59	0.09	−0.3										2.5		
Eureka	62	73	89	30.00	30.07	+.02	55.7	+1.4	77	5	61	44	1	50	24	52	50	87	.27	−.4	4	5,424	n.	24	n.	22	14	9	7	4.0	.0	.0
Redding	722	20	34	------	------	------	78.7	------	105	5	91	54	14	66	35	58	40	29	.02	------	1	7,029	nw.	24	nw.	13	18	10	2	2.8	.0	.0
Sacramento	66	92	115	29.78	29.85	−.04	74.2	+4.8	103	4	90	50	14	58	41	59	48	48	.00	−.2	0	5,439	s.	19	s.	27	29	1	0	.5	.0	.0
San Francisco	155	208	243	29.75	29.92	−.04	61.3	+2.8	89	3	70	50	9	53	30	53	49	72	T	−.2	0	6,203	sw.	27	w.	13	22	5	3	2.6	.0	.0
South Pacific Coast Region							69.3	+0.6										65	T	−0.1										3.4		
Fresno	327	97	105	29.49	29.83	−.02	78.2	+2.4	105	4	94	52	14	62	38	59	43	36	.00	−.1	0	5,903	nw.	21	nw.	13	29	1	0	.3	.0	.0
Los Angeles	338	159	191	29.53	29.89	−.01	66.4	.0	79	18	75	54	1	58	22	60	57	77	T	−.1	0	3,892	sw.	12	sw.	22	12	16	2	4.1	.0	.0
San Diego	87	62	70	29.80	29.89	−.03	63.4	−.5	70	24	68	56	1	59	12	59	57	83	.00	.0	0	4,894	s.	21	s.	30	8	14	8	5.7	.0	.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.01	------	79.2	−.5	89	9	84	73	28	75	14	----	----	----	3.12	−2.2	15	8,436	e.	31	e.	16	1	25	4	5.6	.0	.0
Panama Canal																																
Balboa Heights	118	6	97	------	[2]29.83	.00	80.0	−.1	90	8	86	72	17	74	16	----	----	[2]90	7.54	−.7	23	3,231	nw.	24	nw.	23	0	6	24	8.1	.0	.0
Cristobal	36	6	97	------	[2]29.85	−.01	80.8	+.4	90	13	86	74	26	76	14	76	75	[2]84	16.26	+2.5	25	4,052	w.	23	n.	8	0	10	20	8.3	.0	.0
Alaska																																
Fairbanks	454	11	87	[3]29.34	[2]29.84	------	56.2	------	78	21	67	34	8	45	30	48	40	63	.84	------	13	4,460	sw.	27	sw.	4	4	15	11	6.6	.0	.0
Juneau	80	96	116	[3]29.84	[2]29.93	------	53.2	------	74	21	60	42	6	46	28	48	44	76	4.73	------	20	4,507	s.	22	se.	18	4	6	20	7.6	.0	.0
Hawaiian Islands																																
Honolulu	38	86	100	[3]29.99	[3]30.03	------	77.4	------	85	11	82	69	4	73	12	70	66	70	.31	−.6	10	6,948	e.	25	ne.	5	10	18	2	4.3	.0	.0

[1] Observations taken at airport.
[2] Observations taken hourly.
[3] Pressure not reduced to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, June 1935*

Stations	Altitude above mean sea level, Jan 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max. + mean min. ÷ 2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*In.*	*In.*	*In.*
Cape Race, Newfoundland	99												
Sydney, Cape Breton Island	48	29.94	29.99	+0.04	58.1	+0.7	65.6	46.6	78	38	1.94	−1.29	0.0
Halifax, Nova Scotia	88												
Yarmouth, Nova Scotia	65												
Charlottetown, Prince Edward Island	38												
Chatham, New Brunswick	28												
Father Point, Quebec	20												
Quebec, Quebec	296	29.59	29.91	−.01	62.4	+1.2	70.2	54.6	82	48	6.26	+2.61	.0
Doucet, Quebec	1,236				55.7		68.5	43.0	80	21	4.72		.0
Montreal, Quebec	187	29.73	29.93	−.01	65.2	+.3	72.5	57.8	82	51	5.09	+1.56	.0
Ottawa, Ontario	236												
Kingston, Ontario	285	29.60	29.91	−.06	62.1	−1.3	69.0	55.3	76	43	4.45	+2.02	.0
Toronto, Ontario	379	29.50	29.90	−.07	62.6	+.2	72.6	54.7	83	42	3.42	+.62	.0
Cochrane, Ontario	930				57.9		69.0	46.9	83	32	3.58		.0
White River, Ontario	1,244	28.54	29.84	−.10	53.6	−5.1	64.8	42.3	79	29	4.30	+2.08	.0
London, Ontario	808												
Southampton, Ontario	656												
Parry Sound, Ontario	688												
Port Arthur, Ontario	644	29.16	29.87	−.07	56.1	−.3	64.6	47.6	79	37	2.54	−.19	.0
Winnipeg, Manitoba	760	29.00	29.82	−.07	57.7	−4.5	67.5	48.0	84	29	4.15	+.86	.0
Minnedosa, Manitoba	1,690	28.04	29.83	.06	55.1	−4.5	65.0	45.2	81	29	6.75	+3.75	.0
Le Pas, Manitoba	860												
Qu'Appelle, Saskatchewan	2,115												
Moose Jaw, Saskatchewan	1,759												
Swift Current, Saskatchewan	2,392												
Medicine Hat, Alberta	2,365	27.34	29.80	−.05	56.6	−5.4	71.7	41.5	90	37	1.06	−1.70	.0
Calgary, Alberta	3,540	26.21	29.84	.09	54.2	−1.8	64.6	43.9	79	34	3.69	+1.24	.0
Banff, Alberta	4,521												
Prince Albert, Saskatchewan	1,450	28.33	29.89	+.02	55.9	−1.8	64.6	47.3	82	35	3.60	+1.09	.0
Battleford, Saskatchewan	1,592												
Edmonton, Alberta	2,150												
Kamloops, British Columbia	1,262												
Victoria, British Columbia	230	29.77	30.02	+.01	57.6	+1.3	65.0	50.3	83	44	.67	−.53	.0
Barkerville, British Columbia	4,180												
Estevan Point, British Columbia	20												
Prince Rupert, British Columbia	170												
Hamilton, Bermuda	151												

SEVERE LOCAL STORMS, JUNE 1935

[Compiled by Mary O. Souder]

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Dundy, Hayes, Hitchcock, Frontier, Red Willow, Furnas, Harlan, Franklin, and Webster Counties, Nebr.	May 31 June 2		[1] 1-3	104	$13,000,000	Flood	1,000 families homeless; 600 to 700 sets of farm buildings swept away or so damaged as to require rebuilding; 213 miles of railroad track washed out and 250,000 acres flooded, path 210 miles long.
Hodgeman and Pawnee Counties, Kans.	1	5 p. m.	100	0		Tornado and hail	Originated 9 miles west of Burdett, ended 3 miles northeast; no buildings struck; at least 3 tornado clouds seen; path 12 miles long.
Euclid, near, Minn.	1	9 p. m.	880	0	1,000	Small tornado	Barns demolished; house moved from its foundation; farm machinery destroyed; uprooted trees strewn on ground in different directions; roof of barn reported lifted about 80 feet in the air; path 1 mile long.
Dodge City, Kans., vicinity of.	1	p. m.		0		2 tornadoes	Passengers arriving on a train from the east the evening of the 1st reported seeing 2 tornadoes, one about 15 miles north of Kinsley, the other a few miles west of that point; no damage reported.
Sumner County, Kans.	2	3 p. m.	880	0	100,000	Tornado	Originated 1 mile southwest of Perth, narrowly missed South Haven and ended near Fairfax, Okla.; 9 persons injured; 14 farm houses and many other smaller buildings destroyed; path 15 miles long in Kansas; estimated damage for Kansas only.
York, near, Nebr.	2	4 p. m.	333	0	1,000	do	Buildings on 2 farms damaged.
Lincoln, Nebr.	2	4-4:30 p. m.	[1] 3		100,000	Hail	Loss in wheat, oats, barley, and alfalfa on about 100 sections of land.
Newkirk to Fairfax, Okla., and vicinity.	2	4:30 p. m.	33-50	0		Tornado	Tornado originated near Perth, Kans., and moved southeastward to the vicinity of Newkirk, Okla.; 3 persons slightly injured; loss to crops and damage to buildings or other property in Oklahoma not estimated.
Washington, Idaho.	2					Heavy hail	Loss to potato crop, alfalfa, and grain.
Lincoln, Nebr.	5	6:15 p. m.	167	0	2,000	Small tornado	Storm was reported as having a light, flimsy-appearing funnel cloud which tossed twigs and shingles into the air as it whirled; chickens killed and poultry house wrecked; trees uprooted.
Sykesville, Md.	5	p. m.			2,000	Electrical	Rectory damaged.
Grove, Kans., vicinity of.	6	6-7 p. m.	[1] 3		30,000	Heavy hail	Crops totally destroyed; hailstones drifted 6 feet in draws; path 12 miles long.
Johnson County, Ark., southeastern portion.	6		880-1,760		16,000	Hail	Gardens, peach orchards, and crops destroyed.
Albany and Sauk Center, Minn., and vicinity.	8	Noon	[1] 3-4			do	Light to heavy hail; some growing crops totally destroyed; path 50 miles long.
New Hope and Harriston, Va., and vicinity.	8	4-5 p. m.	[1] 3-4		50,000	do	Loss to crops and poultry.
Richmond, Va., and vicinity.	8	6-11 p. m.				Thunderstorm and hail.	Hailstones as large as golf balls, driven before high winds, punctured automobile tops; considerable damage to fruit trees and truck gardens; southbound traffic delayed by heavy rain.
Stuarts Draft to Staunton, Va.	8	p. m.			100,000	Heavy hail	Loss in heart of Virginia apple belt; Union Apple Co. and Alta Vista orchards hard hit.
Prentiss County, Miss., northern portion.	8					Hail	Storm reported as damaging; no details.
Boyceville to Menomonee, Wis., vicinity of.	8		[1] 6		3,000	do	Loss to crops; path 30 miles long.
Wright, Meeker, and Stearns Counties, Minn.	9	4:30 p. m.			5,000	Wind and hail	Some damage to barns and small buildings; 2 persons injured; crop loss $5,000.
Garvin, near, Minn.	9	5:45 p. m.	25	0		Tornado	Damage mainly to barns and small outbuildings which were all either badly damaged or demolished on 7 farms; 3 persons injured; livestock killed; path 9 miles long.
Albert Lea, Minn.	9	8 p. m.	440		25,000	Electrical and wind.	Roof of American Gas Machine Co. plant torn away and machinery damaged by water; large tree uprooted; Jefferson Motor Co. building damaged; several cottages near the shore of Albert Lea Lake engulfed by huge waves created by the wind; considerable minor damage occurred in a number of extreme southeastern counties.
Mankato, Minn., vicinity of.	9		[1] 1		4,000	Hail	Considerable damage to growing crops, some being almost total loss.
Sacred Heart, Minn. vicinity of.	9		2,640		4,000	do	Many windows broken; roofs of buildings damaged; flax almost a total loss; small loss to other grain.
Waco, Nebr.	10	1 a. m.	[1] 1		1,000	do	Damage to property.
Greeley, Colo.	10	5:30 p. m.	[1] 1-5			do	Severe loss to 3,000 acres of beets and 12,000 acres of other crops; roofs damaged; amount not estimated.
Fergus County, Mont., eastern portion.	10					do	Several thousand dollars loss to crops and damage to property.
Cheyenne, Wyo., and vicinity.	10-11	11:40 p. m.-12:20 a. m.				Heavy rain and flood.	0.59 inch of rain, largest amount recorded in 5 minutes in the history of this station; basement of Federal Office Building flooded with 6 inches of rain; people forced out of basement apartments and their furniture and household goods damaged; a crew preparing a Burlington train for departure were forced to abandon their work: Burlington officials did not send trains out on their Casper-Cheyenne route during the night; a cloudburst, noon of the 11th, sent torrents down Bear Creek and Chugwater, 30 to 50 miles north of Cheyenne, washed both approaches of the bridge; some highways closed.
Steamboat Springs, Colo., vicinity of.	11	5 p. m.	2,640			Hail	Some hailstones as large as walnuts; considerable damage to alfalfa and small damage to gardens; amount not estimated.
Dodge City, Kans., vicinity of.	11			0		Tornado and thunderstorm.	A small tornado was reported south or southeast of Dodge City during the thunderstorm on the 11th; no damage reported.
Albuquerque, N. Mex.	11					Heavy rain, electrical.	Rain caused much damage by flooding basements and streets; 2 fires caused by lightning.
Yakima and Wenatchee, Wash., and vicinity.	12	12-3 p. m.	220		65,000	Hail	Estimated losses of crops $40,000 near Yakima and considerable damage to apples and pears southeast of Sunnyside; $25,000 loss in the Wenatchee Valley; path 2½ miles long.
Vona, Colo.	12	5:30 p. m.				Heavy rain and flood.	As a result of a heavy downpour, a reservoir broke releasing a wall of water 15 feet high, causing a flood; 75 feet of railway track washed out.
Oketo, Kans., 5 miles east	12	6 p. m.	220	0	800	Small tornado	Tornado had strong side winds; chief damage to farm buildings, path 5 miles long.
Corpus Christi, Tex., 5 miles southwest.	12	8 p. m.	33	0		do	Tornado came during a torrential shower with a squall from the east; several barns destroyed and trees uprooted.
Parker, Colo., vicinity of.	12	8:30 p. m.	[1] 3½		2,000	Hail	Considerable loss to crops and gardens.
Escanaba, Mich., and vicinity.	12	12 p. m.	25-33	0	5,000	Tornadic winds, thunderstorm, and hail.	At Pine Ridge, 5 miles west of Escanaba, a garage, tourist cabin, and several shacks were demolished; many trees uprooted or twisted off fell across the highway and communication lines; path of storm 1 mile long; $5,000 amount of damage from wind only; storm rather severe and confined mostly to gardens and damage was considerably restricted owing to backward stage of vegetation.
Ballantine, Mont.	12	p. m.	4-8			Wind and hail	Storm lasted from 5 to 10 minutes; amount of damage not estimated; most of the badly damaged crops were reseeded later.
Green Bay, Wis.	12				3,000	Hail	Truck gardens and other crops damaged.

[1] Miles instead of yards.

SEVERE LOCAL STORMS, JUNE 1935—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Clay and Becker Counties, Minn.	13	7-7:45 p. m.	30	0	$62,000	Tornado and hail	Many barns, outbuildings, and silos demolished; houses and buildings damaged; trees uprooted; poles and wires down; some livestock killed; several persons injured; heavy rain accompanied the storm in some places; path 15 miles long; tornado damage $50,000; hail $12,000.
Bozeman and Belgrade, Mont.	13	p. m.				Hail	Some damage to windows, roofs, and automobiles; considerable damage to alfalfa, grains, and peas.
Del Rio, Tex.	13			8	92,000	Excessive rain and flood.	8.88 inches fell in 24 hours causing an unprecedented rise in San Felipe Creek which overflowed; 4 Mexicans were drowned when they refused to heed the warning of the impending rise and remained in their home which was washed away; 4 others missing, it is presumed they are drowned; property damage estimated to be $10,000; damage to bridges and highways $82,000.
Garfield and Prairie Counties, Mont.	14	3:30 p. m.			15,000	Wind and hail	5 persons injured; many lambs and ewes killed, one owner reporting the loss of 150; much crop loss and many windows broken; in Garfield County the loss, excluding crops, was $15,000; no estimate given for Prairie County.
Isidore, N. Mex.	14	5 p. m.	[1] 1			Heavy hail	Much damage to gardens and crops.
Onida, S. Dak., vicinity of	15	2:30-3 p. m.	55-165	0	25,000	Tornado	5 persons injured; farm buildings and implements wrecked; 60 cattle killed; small loss to crops.
Harrison, Nebr.	15	4 p. m.	[1] 1		10,000	Hail	Damage to property.
Chadron, Nebr.	15	4:40 - 5:10 p. m.	1,333		20,000	do	Masses of ice as large as base balls reported; property damaged.
Tenney, Minn., vicinity of	15	6-7 p. m.		0	20,000	Small tornado and heavy rain.	A number of barns demolished; silos and windmills blown down; large trees uprooted; some livestock and poultry killed or injured; path 5 miles long.
Clark, S. Dak., vicinity of	15	8 p. m.	[1] 5-6		6,000	Wind	Farm buildings damaged; crop loss negligible.
Kaufman, Tex.	15			1		Tornado	Farmhouse destroyed.
Casper, Wyo.	15				6,500	Hail	Stones ranged in size from peas to golf balls; car tops were punctured and trees stripped of foliage and twigs; several greenhouses damaged and many plants ruined; $6,500 estimated amount to one greenhouse.
Minneapolis and St. Paul, Minn.	15-16				16,500	Heavy rain	2.19 inches of rain recorded in 24 hours; damage to wooden block pavements and otherwise estimated as $11,000 in Minneapolis and $5,500 in St. Paul.
Austin, Tex.	15-16				1,000,000	Flood	Property damaged; advance warnings of the impending flood enabled property owners to save a large amount of movable property; no loss of life reported.
Duluth, Minn., to Superior, Wis.	16	12:45 a. m.	[1] 1	0	100,000	Tornadic winds	Storm occurred along the bay front from 15th Avenue West to 50th Avenue West in Duluth and from Conners Point to South Superior in Superior, Wis.; several bridge operators reported wind velocity of 71 miles recorded between 12:45 and 1:00 a. m., in the vicinity of severe damage on the bay front in Superior; the Pennsylvania and Reading dock wrecked, this and the Duplex Manufacturing Co. in South Superior were hardest hit; trees, garages, and small buildings demolished; 2 points hardest hit were 4½ miles apart; $80,000 damage in Superior and $20,000 in Duluth; path 4½ miles long.
Brainerd, Minn.	16	a. m.			5,000	Electrical and heavy hail.	Garage struck by lightning; basements flooded and foundations partly washed out; some washing of crops.
St. Francis, Kans., vicinity of	16	7 p. m.	[1] 6		40,000	Heavy hail	Damage to crops; path 12 miles long.
Cheyenne, Okla., vicinity of	16	8 p. m.		0	29,680	Tornado	Loss to crops $21,680; damage to property $8,000; strong straight-line winds occurred in the vicinity of Cheyenne simultaneously with the tornado over an area about 20 miles wide and 35 or 40 miles long.
Chicago, Ill.	16	p. m.				Thunderstorm and heavy rain	Streets, basements, and underpasses flooded with resultant delays in traffic.
Okay, Okla.	17	2 p. m.	440		1,000	Wind	Property damaged; path 880 yards long.
Muskogee, Okla.	17	2:30 p. m.	500	0	155,000	Tornado	5 persons injured; several business houses demolished; windows shattered in the downtown section and many large trees throughout the residential district were uprooted; crop loss $5,000; property damage $150,000; path 1 mile long.
Sallisaw, Okla.	17	3:30 p. m.	200-880	0	5,000	do	Few buildings demolished, several others unroofed; windows shattered.
Benton County, Ark.	17			0		Tornadic winds	Shade trees uprooted; power, telegraph and telephone lines broken; small outbuildings blown down; damage of several thousand dollars.
Augusta, Ga., 4 miles west	17					Wind	Doors blown off hangar and 2 planes damaged; trees uprooted; no severe wind in city proper.
Albert Lea, Minn., and vicinity.	17				41,500	Heavy rain	Damage to tangible property estimated at $25,000; farm property $16,500; many acres of lowlands under water.
Pender and Onslow Counties, N. C.	18	P. m.		1		Thundersquall and hail.	Considerable damage to tobacco and other crops; trees uprooted; man killed and another seriously injured by a falling tree near Rocky Point.
Bethune, Colo.	18					Heavy rain	3 inches of rain that fell in a few hours produced a torrent of water that carried away a highway bridge and a steel railroad bridge.
Chicago, Ill.	18					Thunderstorms	Storms were accompanied by excessive precipitation in the immediate vicinity of this station; streets, underpasses and basements flooded.
Hagerstown, Md., and vicinity.	18				100,000	Thundersquall	Number of homes and buildings unroofed or damaged; many trees uprooted; fences and poles down.
Camargo, Okla., and vicinity	19	2:15 p. m.	[1] 10		2,000	Hail	Some damage to roofs; principal loss to growing crops; path 20 miles long.
Canute, near, Okla.	19	4 p. m.	[1] 4		11,000	do	$10,000 crop loss; $1,000 damage to buildings; path 15 miles long.
Ralls, Tex.	19	5:45 p. m.	[1] 10	2	150,000	Wind	15 persons injured; buildings and windmills damaged.
Custer to Gage Counties, Nebr.	20	4-5:30 a. m.	[1] 10-15		1,000,000	Hail	Probably 100,000 acres of grain seriously damaged; heavy hail at intervals over a strip 180 miles long in Nebraska; storm extended into Kansas.
Fairfax, Okla., vicinity of	20	6:30 p. m.	880	0	7,000	Tornado	5 persons injured; $7,000 damage to buildings in addition to which 5 oil drilling rigs were partially wrecked; path 1½ miles long.
Apperson, Okla.	20	5:30 p. m.	75	0	25,000	do	8 small homes completely wrecked and 4 others partially destroyed; a herd of cattle struck with such force that 186 of the stampeding animals were killed; loss to crops and gardens.
Washington and Marshall Counties, Kans.	20	6-7:30 a. m.	[1] 11	0	150,000	Tornadic wind and hail.	Storm extended from north-central Washington County through Oketo, Marysville, and Frankfort; chief damage from wind near Frankfort, estimated at $40,000; much window glass broken; crops totally destroyed in many places; path 45 miles long.
Crawford, Cherokee, and Labette Counties, Kans.	20	7:30-8 p. m.				Wind and rain	Storm general over the 3 counties; chief damage to power and telephone lines totaled several thousand dollars; amount not estimated.
Leavenworth and Kickapoo; Kans., vicinity of.	20	9 p. m.	[1] 4		75,000	Heavy hail	Loss mostly to wheat, alfalfa and fruit crops; path 8 miles long.
Grannis, Ark., vicinity of	20				1,000	Heavy hail	Cotton, corn, and other crops destroyed.
Newton and Jasper Counties, Mo.	20					Wind and rain	Severe storm came from Kansas into Newton and Jasper Counties, Mo., doing considerable damage in the vicinity of Joplin and Neosho; amount of damage not available.
Sioux County, N. Dak.	20			1		Tornado	A girl killed during the tornado; no details.
Texarkana, Ark.	21	8:30 a. m.	880-1,760	4	300,000	Tornado	From New Boston, Tex., to Texarkana, Ark., in Arkansas; airplanes, airport, and buildings damaged; 15 persons injured: path of destructive winds 30 miles long.
Double Tollgate and White Post, Va.	21	7 p. m.	[1] 1-2		6,000	Wind	Damage to barns and outbuildings $2,000; crop loss $4,000.

[1] Miles instead of yards.

SEVERE LOCAL STORMS, JUNE 1935—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Strasburg, Va., to Harpers Ferry, W. Va.	21	p. m.	440–1,760		$4,000	Wind	Several buildings unroofed; minor loss to crops.
New Mexico, eastern side of State.	21					Dust	A rather general storm occurred over the eastern side of the State and in the lower Rio Grande Valley.
Tampa, Fla., vicinity of	24	10:30 a. m.	200	0	3,000	Tornado and heavy hail.	A 2-story house toppled over severely injuring a woman; roof and sides of the Seminole ice plant garage blown 75 feet, lodging against trees; a number of liveoaks blown over; all debris and trees blown to a northeasterly direction; buildings destroyed were of poor construction; path 7 to 8 blocks long.
Stillwell, Okla., 8 miles north	24	2:30 p. m.	[1] 1		10,000	Hail	Loss principally to crops; path 6 miles long.
O'Neill, Nebr., vicinity of	24	6 p. m.	333	0	5,000	Tornado	Property damaged.
Davison, Miner, Beadle and Clark Counties, S. Dak.	24	6–7:30 p. m	[1] 1–10		52,000	Wind	Line squall from southwest; communication systems crippled; farm buildings and machinery wrecked; 2 towers of the Coast and Geodetic Survey demolished; trees blown down; 3 persons injured and cattle killed; estimated property damage $51,000; loss to crops $1,000.
Warren, Minn., vicinity of	24	6:30 p. m.		0	4,500	Small tornado	Farm buildings demolished; silos wrecked and trees uprooted; path 25 miles long.
Ortonville, Minn., and vicinity.	24	8 p. m.			5,000	Severe winds	7 persons injured, 6 as the result of a large circus tent being overturned and the canvas torn to shreds; path 25 miles long.
Lake Benton, Minn	24	8:30–9 p. m			7,500	Wind	Winds described as rotary; uprooted trees found lying on the ground in same general direction; a number of barns moved from their foundations; several wooden silos wrecked; standing grain lodged; path 25 miles long.
Huron, S. Dak	24					Line squall	Wind of 46 miles per hour from the west recorded; much damage to trees and shrubs; some damage to sheds and other light structures.
Arriba, Colo., vicinity of	25	4 p. m.	[1] 10			Hail	Hail the size of large marbles caused considerable damage to early gardens.
Cheyenne County, Kans., northwest portion.	25	6 p. m.	[1] 4		108,000	Heavy hail	Loss to crops; hailstones in drifts 4 to 5 feet deep in some places; path 18 miles long.
Scott City, Kans., vicinity of	25	10:30 p. m.	[1] 5		5,000	do	Loss to crops; path 15 miles long.
New Haven, Conn., vicinity of.	25					Thunderstorm and hail.	7 thunderstorms on this day; hail and lightning caused much damage near the city.
Omaha, Nebr	26	1–7 a. m.	[1] 20		200,000	Excessive rain	Damage to streets, sewers, and residences; basements flooded, the gas company measuring a water-level of 7 feet, 3 inches above ground.
Des Moines, Iowa	26	a. m.				Heavy rain	Street temporarily flooded in low spots with water a foot deep; automobiles stalled; damage to pavements; washing of ballast from car tracks; water in basements.
Grand Rapids, Mich	26	1:29 p. m.				Excessive rain	1.36 inches fell in 59 minutes; streets flooded in the city and outlying districts; automobiles forced to make their way in streams of water; graveled roads impassable; manhole covers forced open spraying streams of water to a height of 2 feet or more; basements flooded in sections of the city that normally are considered high ground.
Paxton, Sherman, and Morgan, Minn.	26	4:30–5 p. m	2,640			Heavy hail	Considerable damage to growing crops; in some places small grains were a total loss.
Norwood, Minn	26	6:30 p. m.	[1] 3			Hail	Considerable damage to growing crops; some windows broken.
Stewartville, Minn., vicinity of.	26	8 p. m.	2,640		10,000	do	Loss to crops.
Valentine, Nebr	26	p. m.	[1] 1		10,000	Excessive rain	Damage to property.
Council Bluffs, Iowa	26					do	Approximately $200,000 loss to property.
Rusk County, Wis	26				3,000	Hail	Considerable damage to canning peas, small grains, and gardens.
Abbott, N. Mex	27	1 a. m.				do	Gardens damaged.
Ord, Nebr., vicinity of	27	10 a. m.	[1] 2	0	1,000	Tornado	Property damaged.
Merna and Broken Bow, Nebr.	27	1–1:30 p. m	[1] 4		10,000	Hail	Damage to property.
Hamilton County, Nebr., northern portion.	27	2 p. m.	[1] 3		25,000	do	Property damaged.
Doretta, N. Mex	27	3 p. m.	880			Heavy hail	Gardens, beans, and early crops almost total loss.
Ravenna to Cairo, Nebr	27	3:30–6 p. m.	[1] 10		25,000	Hail and heavy rain.	Property damaged.
Utica, Nebr., vicinity of	27	4 p. m.	[1] 3		5,000	Hail	Property damaged.
Nelson, Nebr	27	6:15 p. m.	[1] 16		80,000	Hail and heavy rain.	Damage to property.
Colorado Springs, Colo	27	p. m.			50,000	Hail	Heavy damage to street lights, electric signs, automobile tops, trees, and shrubs; some hailstones half the size of hen eggs.
St. Francis, Kans., vicinity of	28	6 p. m.			40,000	Heavy hail	Loss to crops.
Adams County, Kans., southern portion.	28	11:30–11:45 p. m.	[1] 3		50,000	Hail	Except for some light damage to grain and hay, loss was confined to damage to fruits; path 7 miles long.
Hatch, N. Mex	28	p. m.	100	0	6,000	Tornado	2 buildings unroofed; numerous plate-glass windows broken.
Clinton, Iowa	28					Heavy rain and flood.	1.05 inches of rain fell in 20 minutes; streets covered with rocks, dirt, and other debris, in some places, ranging to a depth of 4 or 5 inches; highways and basements flooded; roadbeds and approaches to bridges and trestles washed out; some districts reported 4 inches or more of rain during this storm.
Fergus County, Mont	29	5 p. m.	[1] 3		25,000	Hail	Loss mostly to crops; path 10 miles long.
Harrisburg, Pa., and vicinity	29					Electrical, wind, and hail.	Severe hail stripped many trees, cut corn into shreds and uprooted potatoes; many trees blown down; lowlands flooded; in Carlisle the storm was severe and cellars and sewers were flooded; dwellings unroofed and many trees blown down; lightning disrupted electric service and set fire to a hay field.
Custer, Keystone, and Sylvan Lake, S. Dak., vicinity of.	30	11:30–11:40 p. m.	1,980			Heavy hail	Car tops and cabin roofs punctured; trees stripped of small branches; some crop loss.

[1] Miles instead of yards.

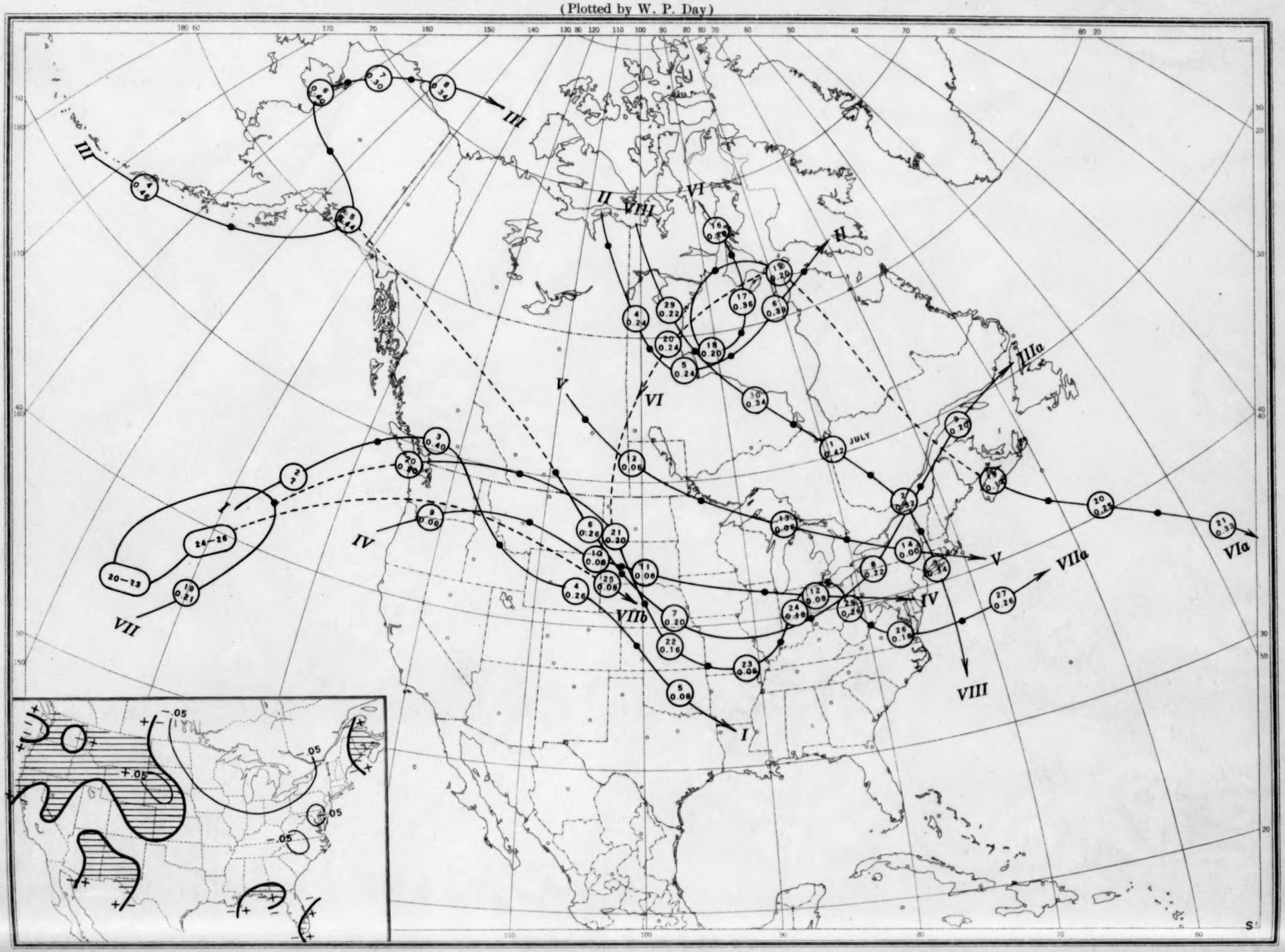
Chart I. Departure (°F.) of the Mean Temperature from the Normal, June 1935

Chart I. Departure (°F.) of the Mean Temperature from the Normal, June 1935

Shaded portions show excess (+)
Unshaded portions show deficiency (−)
Lines show amount of excess or deficiency
Statute Miles
Kilometers

Chart II. Tracks of Centers of Anticyclones, June 1935. (Inset) **Departure of Monthly Mean Pressure from Normal**

(Plotted by W. P. Day)



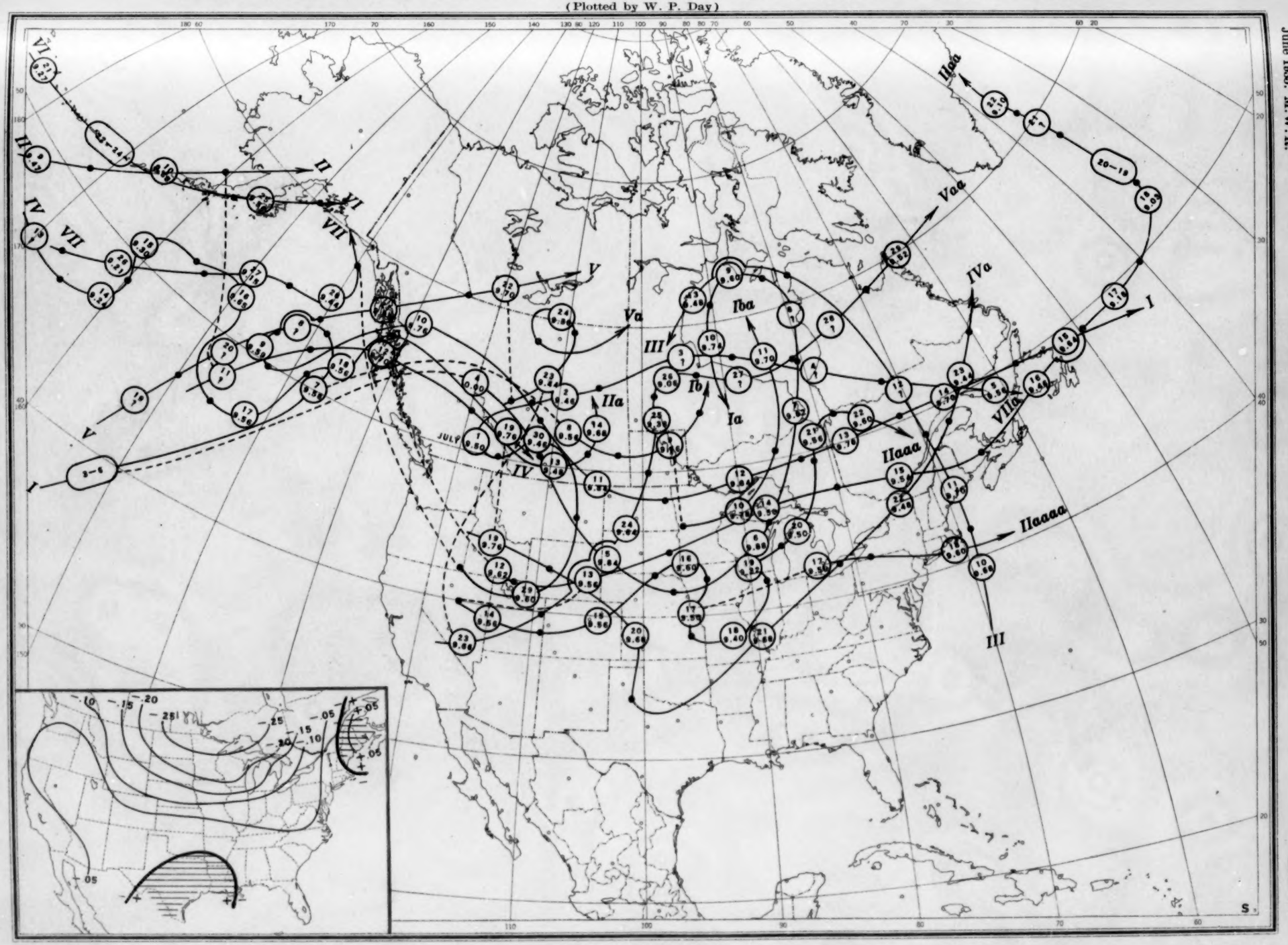
Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, June 1935. (Inset) **Change in Mean Pressure from Preceding Month**

Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, June 1935. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by W. P. Day)



Circle indicates position of cyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 8 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, June 1935

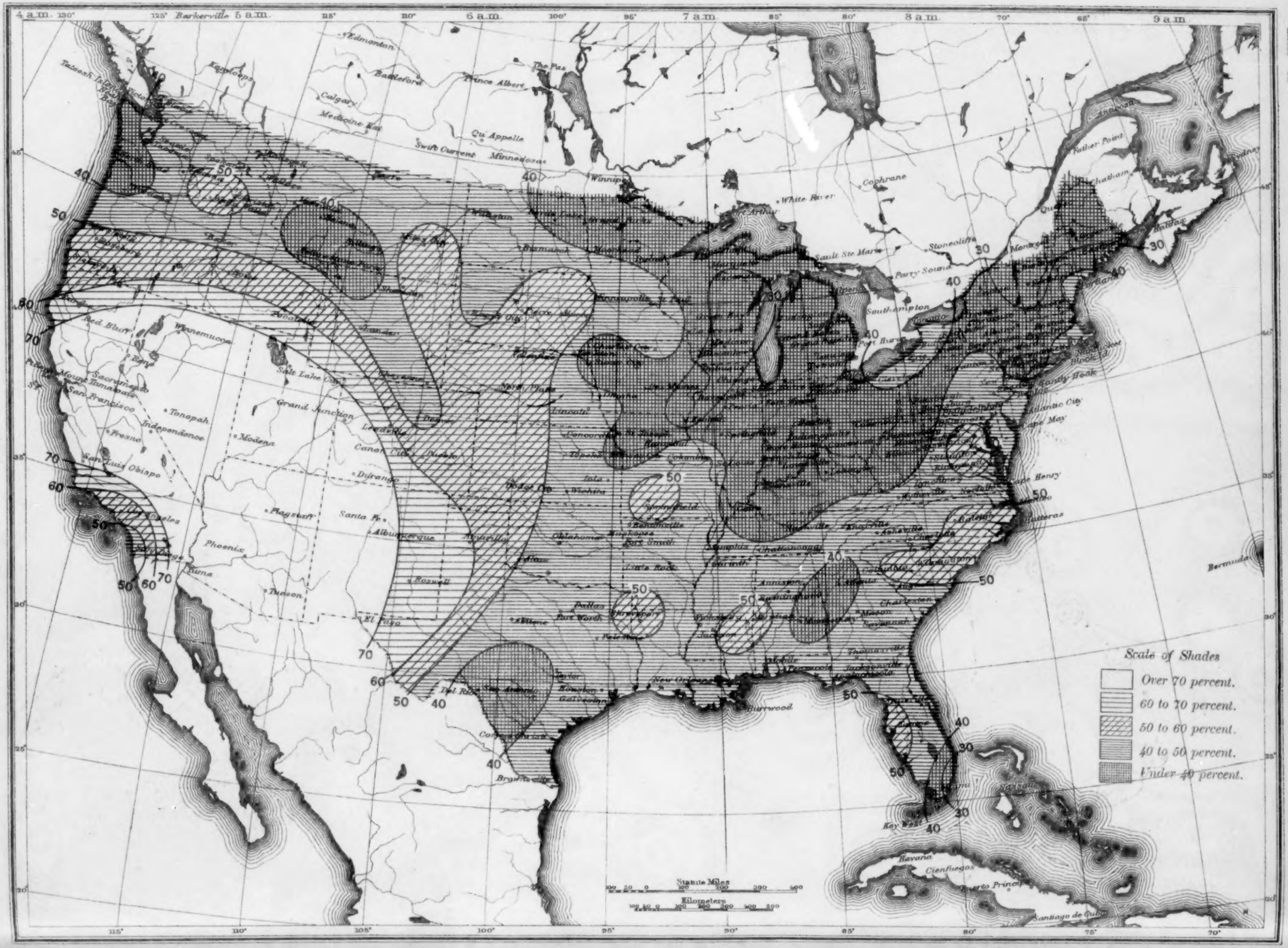


Chart V. Total Precipitation, Inches, June 1935. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, June 1935. (Inset) Departure of Precipitation from Normal

Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, June 1935

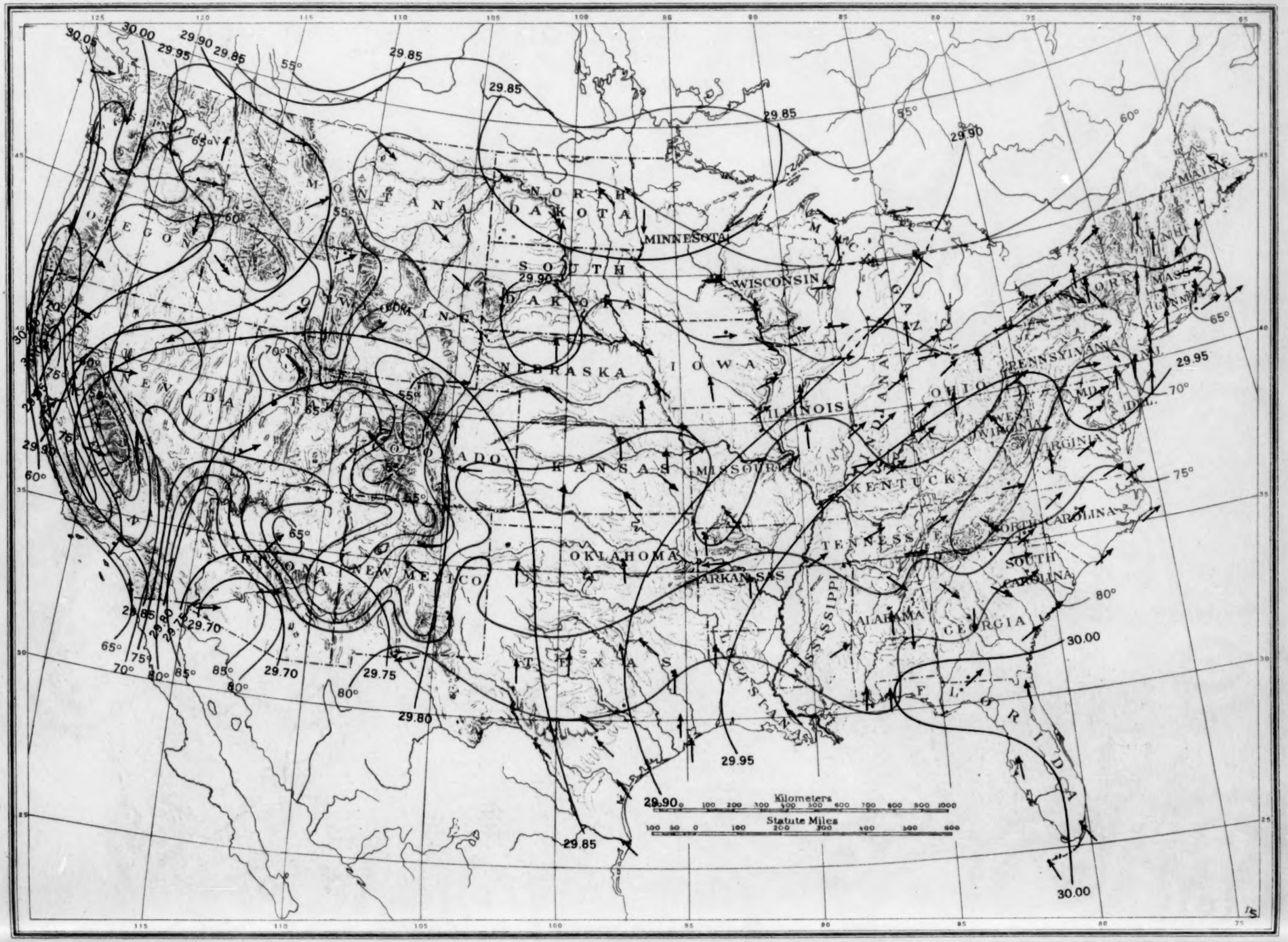


Chart VII. Wind Roses for Selected Stations, June 1935

Chart VII. Wind Roses for Selected Stations, June 1935

(Plotted by E. Corbin)

June 1935. M. W. R.

LXIII—65

UNIV. OF WICH.